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AGRICULTURAL JOURNAL

ISSUED QUARTERLY BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 3.]

FIRST QUARTER, 1930.

[No. 1.

EDITORIAL.

A SUCCESSFUL Agricultural Conference, presided over by His Excellency the Governor, was held in the Supreme Court House, Suva, on January 17th and 18th, 1930. The Conference was originally planned as a purely Departmental function for the Staff, but, at the express wish of His Excellency the Governor, its sphere was extended and the proceedings were made public. There was a representative gathering at the opening of the proceedings and keen interest was taken by all who attended, as is evidenced by the discussions on the papers read, which are published in this number of the *Journal*. The occasion of the Conference afforded members of the Department, many of whom are situated in distant parts of the Group, an opportunity to meet and discuss various matters of interest not recorded in the proceedings. The Superintendent of Agriculture and Mrs. Barnes were "At Home" to members of the staff and their wives on the afternoon of January 17th, when an enjoyable time was spent. It has been decided to make the Conference an annual function of a public nature and to invite contributions from members of the agricultural and commercial community, as well as from members of the Department. It is probable that the occasion of the Fiji Agricultural Show will be a convenient time at which to hold the Annual Conference. Open discussion of agricultural problems cannot but be beneficial, and a closer co-operation between the Agricultural Department and the community can best be effected by the holding of periodical conventions of this nature.

THE DECEMBER STORM.

It is unfortunate to have to record that a serious cyclonic storm visited the Group early in December and caused considerable damage to standing crops and property in certain districts. In Vitilevu the storm was accompanied by exceptionally heavy rainfall, which caused a serious flood of the Rewa river and resulted in considerable damage. The adverse effects of the storm were reflected in the banana shipments for the months of December and January. It will be a few months before the quantity of fruit available for export becomes normal. It is comforting to note, however, that serious as the damage was in many areas, investigation proved it not to be so great as was originally estimated. The field staff of the Agricultural Department has made surveys of the storm damage in various districts and a number of officers took prompt measures in regard to relief work. Mr. Anson, Cotton Specialist, and Mr. Field, Cotton Inspector, are particularly deserving of praise in this connection. They have been officially thanked for their services on storm relief work by His Excellency the Governor.

LIVE STOCK RECORD ASSOCIATION.

The quarterly meeting of the Board of Directors of this Association and the annual general meeting were held on December 17th. The Minutes

of the meetings will be found in this number of the *Journal*. All interested in the stock industry are urged to become members of this Association which has for its object the improvement of cattle, horses and other stock in Fiji.

TAILEVU DAIRY SCHEME.

His Excellency the Governor, attended by Sub-Inspector W. J. G. Holland, A.D.C., and accompanied by the Superintendent of Agriculture and the Secretary of the Tailevu Dairy Scheme, visited the Tailevu district on Thursday January 30th, returning to Suva on 1st February. The party landed at Lodon and after a ceremonial welcome by the native community, walked along the track of the proposed Lodon-Korovou road to the end of the completed portion of the road near Burerua. They proceeded by car to Korovou and afterwards drove over the northern section of the Korovou-Naduruloulou road. The following day His Excellency inspected the school and the dairy factory, afterwards presiding over the annual general meeting of the suppliers of butter-fat to the Tailevu Dairy Factory. After an informal lunch kindly provided by the settlers and their wives His Excellency and party inspected each homestead on the Government Tailevu Dairy Scheme. In the evening His Excellency was "At Home" to settlers, their wives and families at the house of Mr. W. T. Gatward. The keen interest taken by His Excellency the Governor in all affairs connected with the Settlement cannot but be attended by excellent results. There can be no doubt that whatever the past history of the Settlement may be, it is now firmly established and can look forward to a prosperous future. The matter of communications evidenced by the construction of the main road from Naduruloulou and the excellent system of local roads now being pushed in the direction of Lodon by the Tailevu Road Board will remove the feeling of isolation hitherto experienced by the residents and inspire them to increased exertion. They were assured at the last meeting of Legislative Council of a sympathetic consideration by Government and that assurance has been exemplified by His Excellency's visit.

STAFF NOTES.

Mr. C. R. Turbet, B.V.Sc., returned from leave and assumed duty as Chief Veterinary Officer on the 11th January, 1930.

Mr. H. M. Stuchbery, B.V.Sc., proceeded on three months' leave on 18th January, 1930.

Mr. T. H. C. Taylor, B.Sc., sailed for Java on coconut investigation work by the "Niagara" on 29th November, 1929. He is due to return by the repatriation vessel "Sutlej" scheduled to arrive in Suva on February, 28th, 1930.

Mr. G. A. Wishart, Assistant Inspector of Produce, resigned his appointment with effect from the 20th November, 1929.

Mr. L. B. Greaves, Temporary Inspector of Plantations, has been gazetted Acting Assistant Inspector of Produce, temporary, with effect from the 20th November, 1929.

Mr. B. F. Hooper has been appointed Assistant Agricultural Officer, temporary, and has assumed charge of the Nasinu and Navuso Experimental Stations. Mr. Hooper took up duty on the 1st January, 1930.

Mr. T. R. Colebrook was gazetted Stock Inspector for work in the Northern and Western districts of Vitilevu on the 21st October, 1929.

Mr. J. C. Flemmons joined the Department as an Agricultural Pupil on the 10th February, 1930.

AGRICULTURAL CONFERENCE.

THE following are the proceedings of an Agricultural Conference held at the Supreme Court House, Suva, under the presidency of His Excellency the Governor, Sir A. W. Murchison Fletcher, Kt., C.M.G., C.B.E., on January 17th and 18th, 1930:—

His Excellency the Governor.—Mr. Barnes, ladies and gentlemen, it gives me great pleasure to open this Conference this morning and I am particularly pleased to see such a good muster in view of the short notice that the Conference would be open to the public. I attach the greatest importance to a meeting of this kind. We have to live in this Colony by agriculture and it is necessary that we should study by all means in our power the methods by which we can improve the agriculture which we carry on. Here we have the need of expert advice, and we want co-ordination, we want the assistance and co-operation of the community which is actually engaged in planting. What we require is not so much theory as practical agriculture. The Colonial Sugar Refining Company has set us an excellent example in its system for the small tenant farmer. They teach their men how to cultivate, how to rotate crops, and especially they see that they do it. That is all important. That is what is meant by practical assistance of agriculture, and to get practical results requires adult education. Education is very much to the front at the present time in Fiji but I think we should go further than just teaching the "three R's." We should teach the people to live on the soil. It is an excellent thing to teach the young children to read and write, but it is no good to teach only the small boy how to grow potatoes because if he went home and tried to instruct his father he would most likely be cuffed, but if you teach the adult labourer and the small tenant farmer about agriculture his son will learn from him. We have quite a number of interesting papers before us and I will call upon Mr. Barnes to read his paper on "Fruit Production for Export." When the papers have been read I would ask that any persons who are interested in the various papers to take part in the discussions and ask any questions that may occur to them.

Mr. Barnes.—Before proceeding to read the paper which stands in my name I wish to thank Your Excellency for the very keen interest you have taken in this Conference and its objects, and your kindness in consenting not only to open the Conference this morning but to give your most valuable time to be present throughout all its sessions. On behalf of my staff I wish to say that we deeply appreciate this kind thoughtfulness on your part.

FRUIT PRODUCTION FOR EXPORT—PART I,—CITRUS FRUITS.

By A. C. BARNES, F.I.C., B.Sc., A.M.I.Ch.E., Superintendent of Agriculture.

YOUR Excellency, ladies and gentlemen,—I wish to state that my object in preparing this paper for this Conference was to endeavour in the first place to stimulate interest in the growing of citrus fruits for export, and to provide an outline of information for the few people who are keenly interested and who in one or two cases have already taken steps to establish small plantations. I can assure anyone interested in this particular subject that the staff of the Department will be happy to render whatever assistance they can in any way, both in the more theoretical form of lending literature and the practical manner of giving what instruction is possible actually on the ground.

INTRODUCTION.

The cultivation and export of citrus fruits is a subject which has engaged the attention of many of the Colonies and Dominions for some years past. The Union of South Africa, for example, is now one of the largest suppliers to Great Britain and the industry there is very well organised. Fiji by reason of its situation in the tropical belt, its climate and its soil is eminently suited to the production of all grades of oranges, grape fruit, lemons and limes suitable for overseas markets. Although it is unlikely that such an industry will ever assume the same importance as sugar or copra in the Colony, it is nevertheless worthy of a place amongst the more important agricultural industries here. Fiji has before it the lessons learned under great difficulty and expense in other Colonies and should be able to embark on this industry without experiencing so many of the set backs that have jeopardised its success in other places in the past. With any product intended for sale it is essential to establish a standard quality which can be maintained. Any marked irregularity in the quality of fruit offered for sale in overseas markets will seriously affect the esteem with which the public regards that fruit and unless a marketable standard is maintained the whole year round the product is not likely to command a ready sale. Popular varieties of fruit must be grown under carefully controlled conditions; they must be properly harvested at the right stage of development, carefully handled, cured, wrapped and packed in attractive containers for export. Neglect of the most careful attention in every stage of the development of the tree, the harvesting, treatment and export of the fruit will influence the price and the degree with which the product can maintain its place in the market. In this paper a brief outline of the whole process of the production of fruit for export from the establishment of the nursery to the shipment of the fruit will be given.

Plant Propagation.—Though excellent fruit is produced from seedling trees, fruit from different trees is never of uniform quality. The fruit varies in size, texture, flavour, number of seeds and in other characteristics and it is not possible to supply market requirements from the fruit of such trees. It is therefore necessary to resort to some method of propagation whereby a fruit of standard characteristics can be obtained from many hundreds or thousands of trees. This involves some form of vegetative propagation. In the case of citrus, budding is normally practiced. Root stocks are raised from sturdy varieties, generally rough lemon or sour oranges, and are budded at a height of nine inches from the ground when the young plant is about the thickness of a pencil. The best season for budding in Fiji will probably be found to be September–November. Seeds may either be planted in rows and transplanted 18 in. by 18 in. when they are big enough, or they may be planted 18 in. by 18 in. in the first place and budded without transplantation when they are sufficiently well grown. The latter method saves labour and so long as weedy and weak plants are not budded, may be regarded as quite satisfactory. It is, however, essential to utilize only sturdy stocks of a good habit of growth. The young root stocks should be trained to a single stem and branching growth checked in the early stages. This results in much sturdier growth and is likely to influence beneficially the budding operation later to be undertaken. The technique of budding is simple and can be readily picked up after a few trials. Bud wood should be very carefully selected from mature trees of the varieties it is desired to propagate which have borne fruit for several seasons. Bud wood should only be taken from trees of sturdy growth which are known to yield good crops. The wood from which the buds are taken should be one year old.

The buds after insertion in the stem of the root stock should be carefully protected from rain and sun. A binding of tape soaked in a composition of resin, beeswax and tallow should be used and an inverted leaf tied over the bud to protect it from the sun. When the bud has properly united with the stock the upper part of the plant should be cut half through on the budded side and bent over in the opposite direction to force the bud. As soon as the bud has formed a sturdy shoot the stem of the root stock should be cut through a few inches above the bud and as the shoot from the bud or "scion" further develops, the root stock should be cut back carefully with a slanting cut just above the union and the cut surface treated with tar or paint to prevent any access of water. The budded plant will be ready for removal to its permanent home after about two years, but considerable care is necessary during the whole of this period. The "scion" should be trained in the early stages to a single strong stem which should not be allowed to branch too much subsequently. Watering must be practiced whenever the rainfall is insufficient to keep the ground moist. This applies throughout the whole proceedings from the time of the early sowing of the seed until the plant is properly established in its permanent home. Propagation by layering from good trees is another method recommended by some authorities. The technique of this process is described in standard works on fruit culture.

Planting.—The land selected should be well drained, with a free working soil which should be thoroughly cleared of all growth and well cultivated to a depth of 6 in. to 8 in. Planting distances for citrus varieties vary from 15 ft. by 15 ft. to 24 ft. by 24 ft., usually 18 ft. by 18 ft. or 20 ft. by 20 ft. will be found satisfactory. The ground should be carefully lined up and holed some time before the planting operation is to be undertaken. The holes should be 2 feet in diameter by 2 feet deep. When the budded plants are removed from the nursery they should be carefully pruned back to leave only a few strong shoots at the top. The stem for a distance of 18 in. to 2 feet should be quite free from any branching growth. The roots should also be pruned. In planting it will be found that a planting stick is of great assistance. This should be notched in such a manner that two notches correspond with the outer edges of the hole and a notch midway between with the centre. By placing the planting stick across in such a manner that the centre notch is exactly over the middle of the hole it is easy to hold the plant in such a position that it will be planted to the same depth as in the nursery. Surface soil only should be used for filling up the holes and should be carefully worked round the roots by hand, then trodden down in layers in such a manner so as not to cramp the roots or to damage them. It is essential that the plant should not be put in to a greater depth than it was when in the nursery. Shallow planting is much less dangerous than deep planting and allowance should be made for subsidence of the soil in the hole. Collar rot, a serious source of loss of trees, is largely avoided in this way. Care should be taken as planting proceeds to check the lining in all directions, as nothing looks worse than a badly laid out plantation. A good surface mulch should be maintained around the plant and the space between the plants kept under cover either by planting a suitable catch crop or by growing a nitrogenous cover crop. Given satisfactory conditions the plants will soon become established and will give signs of vigorous growth. All shoots which appear on the main stem should be rubbed off with the thumb and finger and should never be allowed to reach the stage where it is necessary actually to cut them with a knife.

Care of Trees.—The plants should be carefully watched to ensure that they develop into well shaped trees and should as a rule be allowed to fork

in only two directions. Subsequent forking of the main branches should, if necessary, be carefully controlled. The object is to get a well shaped tree to all parts of which light and air can obtain free access. In this way the incidence of any disease will be minimised and the tree assisted to bear the maximum quantity of fruit. The trees may be expected to bear fruit in about three years, but for the first one or two seasons the flavour of fruit may be influenced by the nature of the original root stock which will be superimposed upon that of the fruit of the trees from which the buds were taken. This somewhat objectionable characteristic disappears after one or two seasons when the tree settles down to produce a uniform quality of fruit.

Harvesting.—Harvesting of citrus fruit when carried out in a proper manner is not so simple an operation as it would appear. It is essential that fruit be harvested dry and free from dew or mist deposited on the surface. Fruit should always be cut from the trees by special clippers leaving a short length of stalk attached to the fruit. The stem is then again cut as close as possible to the fruit. The harvesters should wear gloves in order to prevent damage to the skin, which is one of the greatest sources of the rotting of fruit by infection of the scratches caused by careless handling as it is cut. The fruit should be loosely packed in boxes fitted with handles for ease of carrying and when boxes are filled they should be transported to the packing station in such a manner as to prevent any bruising of the fruit.

PACKING STATION OPERATIONS.

(a) *Curing.*—The subsequent treatment of the fruit depends largely on the requirements of the market and the time necessarily elapsing between the packing and the consumption. In the case of Fijian fruit it would probably be satisfactory to omit one or two of the operations practiced in those countries which supply fruit to more distant markets than those which are available to Fiji. On arrival at the packing station the fruit should be placed in a dry, cool, well ventilated situation for about two days. During this period surplus moisture passes off from the skin, which becomes somewhat toughened and rendered less susceptible to injury in the subsequent operations.

(b) *Sorting.*—This consists in the culling of diseased, damaged and otherwise unsuitable fruit for export. Any such fruits overlooked during the initial sorting are removed during the sizing and packing stages.

(c) *Artificial Colouring.*—This is often practiced when the fruit as ready for packing is green or irregularly coloured. The object is to obtain a uniform colour of the skin, a condition which greatly adds to the attractive appearance of the fruit. The ripening of the fruit and development of sugar in the juice are speeded up by the process which is now carried out by treatment with ethylene gas in a special manner.

(d) *Washing &c.*—In some instances the fruit is washed, brushed and dried by mechanical means, a solution containing chemicals which prevent the subsequent growth of mould being sometimes used. Grapefruit is afterwards coated with a very thin layer of wax to enhance its appearance.

(e) *Sizing.*—The sorting of the fruit into sizes is done mechanically and the types of machinery used vary with the output of the station. The object is to secure fruits of uniform sizes for packing. This operation cannot be carried out by the hand and eye without mechanical aid, which may however be of quite simple design. With properly sorted fruit, packing is greatly simplified and the standard size of boxes used hold definite numbers

of fruit varying from box to box in accordance with the diameter of the fruit. The standard "packs" for South African fruits are given in 21 (g) of the extracts from Fruit Export Regulations.

(f) *Wrapping and Packing*.—Each fruit is wrapped in thin, tough white tissue paper, cut to sizes suited to the different "packs." The printing of an attractive design on one side of the paper adds to the pleasing appearance of the packed fruit. When wrapped, the design should be on the outside. The whole fruit is covered by paper which is fastened by a firm twist at each end. The operations of wrapping and packing are usually carried on together as the fruit leaves the sizing machine. The method of placing the fruit in the boxes depends on the size, and special printed instructions are used by packers. Loose packing is at all costs to be avoided as the fruit is bruised and spoiled in transit to the market. Standard packs more than fill the boxes, and pressure is necessary to force the fruit down before nailing on the lid. Presses are often used for this purpose. Boxes are of uniform size and constructed to a standard specification.

Inspection and Export Control.—Fruit-exporting counties have realised the necessity for systems of strict inspection and control. In the earlier stages these often appear to bear harshly on exporters, but in the long run their advantages are so obvious as to need no recommendation. They are entirely in the best interests of producers, exporters and consumers.

The following extracts from the latest regulations under the Fruit Export Act 1914 of the Union of South Africa illustrate some of the matters requiring legal enforcement if a fruit export industry is to succeed in holding a satisfactory position in the World's markets:—

REGULATIONS.

1. No fruit intended for export shall be inspected under these regulations unless the requirements of the Perishable Products Export Control Board in respect of the registration of the name, address, distinctive brand and number of the person intending to export citrus fruit, and of the rendering of estimates of intended shipments shall have been complied with.—*Vide* Regulations Nos. 25 and 26 of the Perishable Products Export Control Board, which are contained in the Appendix hereto.

2. For each consignment of fruit examined by the inspector the exporter shall pay at the rate of one shilling and four pence per 40 cubic feet of packages of fruit.

(Attention is also directed to Government Notice No. 1,452 of the 4th September, 1922, prescribing a special fee of 5s. per 40 cubic feet to be paid in respect of the inspection and grading of citrus fruit exported).

5. Every box of fruit submitted for inspection must be consigned to the person or agent appointed by the exporter to arrange the shipment thereof from the various ports, and every consignment shall be accompanied by two Fruit Consignment Declaration Export Notes, in which all the specifications required are given.

6. Boards of reference, composed of persons whose names have been approved for that purpose by the Minister, have been constituted at the ports of Capetown, Port Elizabeth, East London and Durban, and will be established at such other places as may be necessary, to which an exporter may appeal if the inspector refuses to brand or stamp any box of fruit belonging to such exporter.

7. A fee on the basis of 10s. per one ton or portion thereof, and for any quantity over one ton 5s. per ton extra, with a maximum of £5 10s. shall be deposited with the inspector by the consignor of each consignment of fruit upon which the consignor may require the inspector to obtain the decision of the Board of Reference under the provisions of Sections 5 of the Act.

8. The consignor shall, within twenty-four hours of the time of receiving the inspectors' notice remove from the place of inspection any fruit which the inspector has refused to brand or stamp, or which, having been referred to the Board of Reference, has been decided upon by the Board in favour of the inspector. Whenever it shall appear that there is a danger of rejected fruit contaminating other perishables the Fruit Inspector may require the consignor or his agent to remove such fruit forthwith.

(Note.—Attention is invited to Section 6 of Act No. 17, 1914, empowering the Inspector of Fruit to destroy or otherwise dispose of fruit rejected by him for export which is not removed from the place of inspection within the period prescribed by the regulation and providing that any expense of storing pending removal shall be a charge against the owner of such fruit).

9. Boxes of fruit marked so as to represent a grade higher than the correct grade shall be re-marked by the Inspector, and, if otherwise complying with these regulations, branded or stamped by the Inspector as provided in section 4 of the Act.

11. Not less than 5 per cent. of the boxes of fruit in each consignment shall be opened by the Inspector for examination, and all boxes so opened shall be stamped by the Inspector to that effect.

12. Only new and clean boxes or packages shall be used by exporters.

13. Provides for the special marking of boxes.

16. Citrus fruit shall be packed in boxes, the size of which shall be:—

ORANGES AND GRAPEFRUIT.

Outside measurement.—26 in. by 12 in. by 12 in. (with centre piece).

Wood required.—Ends and middle piece (three pieces), $11\frac{1}{2}$ in. by $11\frac{1}{2}$ in. by $11\frac{1}{16}$ in. Top, bottom and sides (eight pieces) 26 in. by $5\frac{1}{2}$ in. by $\frac{1}{4}$ in. Cleats (two pieces) either 11 in. by $\frac{3}{4}$ in. by $\frac{3}{8}$ in. or 11 in. by 1 in. by $\frac{1}{2}$ in.

(The ends of orange boxes and grape fruit boxes are to be firmly fastened together with metal fasteners. No ends or centre pieces are to be made of two pieces of equal width. Cleats for grape-fruit boxes must be coloured red).

(b) *Narrijies.*—Outside measurement, 26 in. by 12 in. by not more than 6 in. deep with centre piece. For the export seasons 1928 and 1929 boxes 18 in. by 12 in. by not more than $4\frac{1}{2}$ in. deep will be permitted but not thereafter.

(c) *Lemons.*—Lemons may be packed in any of the standard citrus packages.

(d) All boxes shall have cleats on the lids. The 12 in. deep boxes shall be strapped at each end and in the middle, but the shallower boxes need not be strapped. The strapping shall be nailed over the cleats, but the middle of the lid shall not be nailed to the centre piece. Wire-bound boxes shall not be allowed.

18. Each citrus fruit shall be wrapped in tissue or other similar paper. If wrappers are descriptive of any particular variety of citrus, such description must agree with the fruit contained therein.

21. The following shall be the grades for the fruits mentioned:—

A—ORANGES.

(a) “Fancy” fruit shall be that which is free from all blemish and injury.

(e) *Maturity.*—No oranges shall be exported unless—

(i) they have attained 70 per cent. yellow or orange colour;

(ii) they show on test not less than the following ratio of total soluble solids to acids:—

Seedlings	5.0	1
Valencia and other late varieties ..	5.5	1
Navels	6.0	1

(f) *Minimum weight.*—The minimum weight of boxes of sizes 80 to 126 shall be not less than 74 lb and all longer counts must weigh not less than 77 lb per packed box; the net weight of the fruit shall be not less than 64 lb and 67 lb respectively.

(g) *Size.*—The size shall not determine the grade. The sizes of fruit shall be as follows:—

Counts of	80	per box,	average diameter	$3\frac{1}{4}$ in.
“	96	“	“	$3\frac{3}{8}$ in.
“	112	“	“	$3\frac{1}{2}$ in.
“	126	“	“	$3\frac{5}{8}$ in.
“	150	“	“	3 in.
“	176	“	“	$2\frac{7}{8}$ in.
“	200	“	“	$2\frac{3}{4}$ in.
“	216	“	“	$2\frac{5}{8}$ in.
“	226	“	“	$2\frac{9}{16}$ in.
“	252	“	“	$2\frac{1}{2}$ in.
“	288	“	“	$2\frac{3}{8}$ in.
“	324	“	“	$2\frac{1}{4}$ in.
“	344	“	“	$2\frac{1}{8}$ in.
“	360	“	“	2 in.

Literature.—A wealth of literature on the varied aspects of citrus growing is available in the form of standard works by authoritative writers and pamphlets issued by Universities and Departments of Agriculture in many countries. A list of such books and papers is kept at the office of the Agricultural Department in Suva. Assistance to those desiring more information than the cursory outline given in this paper will gladly be rendered.

DISCUSSION.

His Excellency the Governor.—I am sure we have all listened with great interest to Mr. Barnes. I recommend to the notice of the Planters' Association what he says about the matters of standard quality and inspection and control. These things are governed by Gresham's Law—a bad coinage drives out a good. In the same way if you allow bad fruit to get on to the market from Fiji your good stuff is tarred with the same brush and you get inferior prices. I can quote an example of the importance of control and inspection in Hong Kong. There the Government guarantees by certificate the quality of tin. The tin is brought into Hong Kong from away back in the hills, sometimes 100 miles distant and a certificate for 99 per cent. fine is given. That certificate is accepted without question all over the world. In the same way you have the Sun Kist Oranges, which are fruit of the first quality. The people of California refuse to ship any fruit that is not of first class quality.

Mr. Faddy.—Where would be the principal markets for citrus fruits grown in Fiji?

Mr. Barnes.—In my opinion the principal markets for Fijian citrus fruit would be New Zealand and Australia. I am aware that New Zealand grows part of its own requirements. As I mentioned in the early part of the paper I do not assume for a moment that citrus production in Fiji will reach large proportions, but I think it is well worthy of consideration.

Mr. Faddy.—At one time we were in the fruit industry in Sydney and we noticed that oranges and mandarines from the islands were very difficult to sell on account of the fact that they were green in colour, and it appears to me that if the citrus industry in Fiji is to be a success it would be necessary to overcome this difficulty by colouring the fruit in some way. The same objection exists in New Zealand.

Mr. Barnes.—Mr. Faddy has raised a very important question. It is a point with which I dealt in the paper when I mentioned the fact that some markets demand a normally coloured fruit. Colouring can be done by comparatively simple artificial means. I would despair of ever succeeding in the education of the British public, whether at Home or in the Colonies to eat green fruit. There is a rooted objection which has been passed down for generations to the eating of green fruit. The cheaper method would be to colour the fruit and send it to them as they like it rather than try to make them buy it as we think they ought to buy it.

Mr. Macdonald.—We have the fruit fly in Fiji which necessitates the early picking of citrus fruit intended for export.

Mr. Barnes.—It should be possible to overcome this difficulty. The matter requires study by the scientific staff.

Mr. SurrIDGE.—The following points occur to me as arising out of your paper on Citrus Fruit:—

1. *Time of budding.*—You state September to November. Would not this be too early for most parts of these islands? I should think November and December.
2. *Budding tape.*—You suggest a resinous tape for the necessary budding. Would not clay or a mixture of cow dung and clay, both substances usually to hand on a plantation, answer the same purpose?
3. *Distance of planting.*—You give a minimum of 15 feet each way. Some parts of Australia plant 12 feet apart. Which do you advise? Also, would you favour the quincunx system of planting, i.e., the equilateral triangle, as against the square system? Either allows for cultivation between the trees, but the quincunx is more economical of space.

4. *Depth of planting*.—In planting young stock, is it not advisable to use the "nursery mark" as control on depth of planting?
5. *Grading of Fruit*.—In dealing with the question of grading, the wholesaler and general public only have been mentioned, but the major loss of bad packing falls on the retailer who, in purchasing, has to stand the loss of bad fruit while maintaining his prices at competitive rates.

Mr. Barness.—The points raised by Mr. Surridge are most interesting and many of them are vital, I think, to the subject under discussion. In regard to the question of the time of budding, I cannot say that I have yet had any experience of any type of citrus fruits in Fiji, but I have discussed the matter with people who have done a certain amount of work here. Mr. Hayes of Sigatoka has budded during the time stated in my paper with excellent results. In connection with the type of budding tape I mentioned, that, I may say, is one of many which is used for the purpose. Reference can be made to any of the standard books on the subject of citrus growing. I would strongly recommend that some such material as that mentioned in my paper should be used in preference to clay or cow dung. The object of the budding tape is to bind the stem firmly and at the same time to prevent the access of moisture to the wound or inserted bud. With regard to the distance of planting, this is a matter which is the cause of some contention amongst planters. I prefer the quincunx system as it allows of planting more trees at the same distance apart in a given area. The distances 9 ft by 9 ft. and 12 ft. by 12 ft. mentioned by Mr. Surridge are far too close. Trees for the first years' growth have ample room for all their requirements, but after four or five years they become so overcrowded that there is the tendency for them to grow high in order to catch the sunlight with the result that the trees have comparatively thin branches which cannot bear the load of fruit that a properly grown tree will, and difficulty in the harvesting of the fruit is caused. In regard to the depth of planting, citrus is subject to collar rot, and though the "nursery mark" is a guide to planting depth, it is preferable to have this slightly above ground level rather than below it.

Mr. Caughley.—I would like to ask Mr. Barnes about the extraction of the juice of the limes.

Mr. Barnes.—This is a point which was considered by a predecessor in my office many years ago who imported a cider press for the purpose of expressing the juice. That press is still at Nasinu. The expression of the juice of the lime and lemon has attained great importance in Sicily and the West Indies. For Fiji to embark upon this industry would involve the establishment of large plantations of different varieties of the fruit mentioned and the industry would demand a high degree of organisation followed by some method of penetrating the market. I think it would be more profitable to go for the fresh fruit markets at first.

Mr. Blackie.—Apparently a great deal of labour would be entailed in the proper control of citrus trees, necessitating expert supervision. Would the products be a marketable success from this point of view?

Mr. Barnes.—This question also is of importance. As I mentioned, I have prepared this paper with the object of interesting people. The degree of organisation should not be very great in the early stages. Everything would depend on the quality of the fruit which was grown and sold in the export markets. There is no reason why the quantity offered for export should not be increased and the quality improved.

Mr. Faddy.—Raised the point about a regulation being in force that prevented anyone sending citrus fruit to Australia in excess of the quantity shipped the previous year and that one year a gentleman could only ship one case of oranges because that was the quantity shipped the previous year.

Mr. Duncan.—The whole question boils down to one of markets. There is no Australian market for Fiji citrus fruits.

Mr. Barnes.—I think there is one important point that has been overlooked and that is the question of the local market. That is a point which is well worthy of attention in the near future. In South Africa, one of the homes of the citrus industry, the industry is highly organised. Growers and producers have formed co-operative societies in the various districts and there is practically no individual marketing of fruit. It should be possible to work on similar lines in Fiji to ensure that local demands are supplied.

Mr. Barker.—Raised the question about the prohibition of the importation of limes into New Zealand.

Mr. Barnes.—I am not aware that there is any prohibition of the importation of limes into New Zealand. I will look into this matter. All these questions require to be explored before embarking upon an industry of this description.

His Excellency the Governor.—I now ask Mr. Anson to read his paper on the Cotton Industry.

RESUME OF WORK AT THE COTTON EXPERIMENTAL STATION.

By R. R. ANSON, Cotton Specialist.

ON the recommendation of Mr. G. Evans, who made a thorough tour of the Fiji Islands during July and August of 1924, I was appointed by the Empire Cotton Growing Corporation and attached to the Government of Fiji as Cotton Specialist. The primary object of my appointment being that of plant breeding on cotton, with a view to raising new and improved types, together with testing new varieties and carrying out experiments on the cultivation. Several varieties have been tried out at the Experimental Station, including:—

Kidney Gossypium Braziliense which was obtained from seed found growing locally and is a perennial shrub or small tree with united or conglomerate seeds and possesses coarse lint used mainly for mixing with wool. The staple measures from 1 in. to 1½ in.

Meade Gossypium Hirsutum.—A variety which originated from a single plant selection made in 1912 by Rowland Meade from a field of Black Rattler. It was introduced into the Sea Island areas of Georgia and South Carolina because Sea Island could not be grown profitably in the regions infested with boll weevils.

Tanguis Gossypium Peruvianum.—Produced originally about the year 1908 by Senor Cermin Tanguis. It is said to be a Hybrid of Egyptian and Semi Rough Peruvian. It is usually grown under irrigation and the staple averages 1-3/16 in. to 1¼ in.

Acala Gossypium Hirsutum.—An American upland variety evolved by G. N. Collins and C. B. Doyle in 1906 from imported seed from Southern Mexico. The present strain was developed from twenty selected plants by Dr. D. A. Saunders, and our seed was obtained from Australia.

Pima Gossypium Peruvianum.—An American-Egyptian variety grown, mainly in Arizona and California and used for manufacturing of tire yarns balloon cloth and aeroplane fabrics.

Sakellarides Gossypium Peruvianum.—An Egyptian cotton which was brought out about the year 1907 from a single plant selection from Jannovitch.

Several of these cottons have been crossed with Sea Island.

The only ones which have shown any promise of becoming commercially successful are:—Sea Island, Kidney and a Hybrid Sea Island Kidney cross, which originated from five of the most promising of twenty-eight single plant selections made by Mr. Evans from Kidney Hybrid cottons found growing at Kayapet, Markham Valley, New Guinea. Of the original twenty-eight selections sent out by Mr. Evans eleven possess conglomerate seeds which did not cling together as in ordinary Kidney cottons. Five of these which appeared to be the best were sent out to Fiji by the Empire Cotton Growing Corporation for trial.

During the past few years the uncertainty of the market for Sea Island cotton made it necessary to try out experiments in order to ascertain whether it will be possible to substitute it by some other variety which would be more saleable, and at the same time, give the grower as good a return per acre.

It is well known that owing to its length, strength and fineness of staple, Sea Island has always commanded a higher price than other cottons, but the size and character of the bolls make picking difficult, and a picker can rarely maintain an average of more than thirty pounds of seed cotton in a ten-hour day. A cotton that will compare favourably with it, from a grower's point of view, must therefore be a type which possesses a larger boll, a higher percentage of lint, a higher percentage of first-grade cotton per acre, a better yielder, and at the same time produces a lint of such quality that the price will be as close as possible to that of Sea Island.

The average percentage of Sea Island A and B grades taken during the first four seasons has been high—69.41 per cent.—and it will not be an easy matter to find a cotton which will beat this. The grade and class are governed to a great extent by weather conditions at the time of maturity, the dryer the weather at picking time the higher the percentage of good quality cotton. According to the rainfall statistics taken over a period of twenty years in the dry zones of Vitilevu and Vanualevu Islands the dryest weather was experienced during the months of June, July, August, September and October. The Sea Island crop when planted in mid November usually reaches maturity in April and picking is continued until the end of August. The Kidney Hybrid planted at the same time does not reach maturity until June and picking is continued until the end of December. This fits in with the dryest months and it is hoped that it will be possible to obtain a higher percentage of first grade cotton than is the case with Sea Island. As far as the present season is concerned this seems to be precisely the case, and the Kidney Hybrid has so far shown many of the other characteristics which are necessary to make it compare favourably with Sea Island, that is *from a grower's point of view*, but the variety, has not been properly fixed to type and a few individual plants show signs of reverting to one or other of the parent plants and it will be necessary to continue with plant selection work until the type has become commercially pure.

For the ultimate fixing of a commercially pure type, the method adopted by most plant breeders is that of the "progeny row" system, which is one based on the separate raising of progeny of individual selected plants. To begin with several plants are selected as being the best to be found, and the seed from each of these is saved separately. The reason for having more than one plant to start with is that the degree to which the characters

of the parent are transmitted are found to vary with different plants. The following year each of these lots of seed is used to establish a row of, say, one hundred plants. The rows should be adjacent to each other and should either occupy an isolated position or be placed amongst cotton of good type. These precautions are taken to prevent, as far as possible, the crossing with pollen from inferior plants. Any plants of noticeable inferiority are pulled up as soon as detected. When plants come into bearing the rows are compared with each other, and the rows which possess the required characters with the greatest regularity are selected. In these again a number of the best plants are marked and the seed from each individual saved separately for next three years' rows. The seed from the remainder of the plants in each selected row is saved and used for planting separate plots, while that from the non-selected rows should also be kept for planting since it may be expected to be above the average. The following year there will be:—

- (1) a new set of rows from the last selected plants;
- (2) as many seed plots as there were selected rows in the previous year;
- (3) a certain amount of cotton planted from seed from non-selected rows.

For reasons connected with crossing already indicated, the seed plots should be planted around the rows. The selection of rows and individual plants, and the planting of seed plots, are repeated in this and each succeeding year. From the seed plots sufficient seed will be obtained each year to plant out a large field. If the seed from this is not sufficient for an isolated community of growers, the process can be carried on another step, using the area upon which the seed cotton is grown as the seed plot for the following year.

A study has been made of the behaviour of each hybrid plant in the progeny rows. All the free-seeded ones were grouped together and careful observations made. Points such as pest resistance, productivity, size of boll, length and uniformity of staple and flower colourings, &c., were noted.

Two plants were selected as being the most uniform and desirable and the seed obtained from these has been planted on increase plots at the Station. Seed from the former, namely K. 3-2., has been chosen for distribution to growers during the current season. This means that the seed from an individual plant has in two years been multiplied up to meet the requirements of all cotton growing areas in the Sigatoka district, roughly 600 acres.

The type of plant which we are attempting to produce is a robust one of open habit, with full opening bolls and strong lint of uniform staple length, resistant to Black Arm *Bacterium Malvacearum* and other fungi encouraged by excess of wet and humidity of which we have so much here. It appears to me that our safest plan would be to produce two types:—

- (1) a coarse stapled cotton measuring about $1\frac{1}{4}$ in. which could be used for mixing with wool;
- (2) a fine stapled cotton measuring about $1\frac{1}{2}$ in. which could be sold against Egyptians.

At the present time both of these types are selling well in the English market. To my mind it is desirable to have as it were, two strings to our bow, so that should one type drop in price we would have a supply of seed from the other and would be able to put it on the market in a short space of time. There is always a danger of wool prices having a direct influence on the price of the rough cottons, and of over production in Egypt and the Sudan influencing the price of Egyptian types. All selection work at the Station has been carried out with this end in view. The best of the coarsest counts have been selected, self fertilized, and planted out on isolated plots in progeny rows.

Self Fertilization.—In order to ensure self fertilization it is necessary to take the flower buds during the evening or early morning before they burst open, and by means of a silken thread being securely tied around the corolla they are prevented from opening. One end of the thread is attached to the stem above the peduncle. The flowers of cotton plants are known to a botanist as complete in that they possess both male and female organs necessary for reproduction. During the afternoon of the following day the stigma becomes receptive and fertilization takes place. No pollen from the surrounding plants has been allowed to enter as the flower has never opened. After about three days the corolla withers up, drops off and hanging by the thread, which as I said before had been attached to the stem above the peduncle, it acts as a label.

In order to obtain the fine type, we have back-crossed selected plants with Sea Island and the seed obtained has been planted in single lines where it will be self fertilized and again selected from during the coming season.

Crossing.—Crossing is a much more tedious business and can only be done by a person who has been thoroughly trained to the work. Flowering buds are taken two days before they are due to open. One petal is removed by means of a fine pair of scissors. The flower is then emasculated, care being taken to see that the anthers have all been removed, and in order to ensure that it cannot be visited by pollen-carrying insects, the flower is then covered by a thin paper bag. On the following afternoon a few flowers are taken from the plant chosen for crossing and pollen from them is placed on the stigma of the emasculated flower. The bag is then replaced and not removed for two days when the young boll is labelled by means of a piece of coloured thread being tied around the peduncle.

Dr. S. C. Harland, Geneticist of the Corporation's Research Station in Trinidad, has kindly supplied some seeds from a Kidney Sea Island Hybrid which has been back-crossed with Sea Island. These have been planted out and their behaviour will be watched with interest. In comparing the two varieties I have taken the highest plot yields obtained last season at the Station for each. With regard to Sea Island I have taken the average price obtained for all grades since the recommencement of the industry, and an estimated average price for the new cotton. Working on this basis we find that—

(a) one acre Sea Island yielded 1,228 lb of s/c at 3.05d.=£16 8s. 8d.

(b) one acre New Variety yielded 1,794 lb of s/c at 2.5d.=£18 13s. 9d.

In two years we hope to bring the quality of the new variety up to an average value of 13½d. per lb. The average purchasing price of one pound of lint at the present rate is estimated at 7½d. The cost of ginning and marketing on a 918 bale crop in 1926 was 5.13d. per lb. This means that should we reach our goal a profit of .87d. plus the prices obtained for cotton seed would be made on every pound of cotton sold.

Judging from reports received from the British Cotton Growing Association there is likely to be a constant demand for up to 10,000 bales of this variety, whereas if we were to produce more than 1,000 bales of Sea Island we would probably flood the market, but at the same time, it would be advisable to keep a stock of pure Sea Island seed on hand in case there should be a good demand for it at some future date, and it should prove more profitable to the growers than the new type. In order to do this it would be necessary to confine an isolated area to the growing of it exclusively and to gin and store it separately. At present it is being grown between Ra and Cuvu and stored and ginned at Lautoka. My own opinion on the matter is that

we would be able to dispose of up to 2,000 bales of Sea Island cotton at a price which would pay both the grower and the ginners, but it is a variety which would not be grown extensively by Fijians, mainly because it is a difficult cotton to pick and needs to be carefully picked over again before it is forwarded to the ginnery, and I am afraid that the work would prove to be too tedious for the Fijian temperament.

If cotton is to be grown by Indians alone it would be a considerable time before the output exceeded 1,000 bales, because consolidated areas settled by Indians who are not engaged in growing either sugar cane or pineapples are few and far between and on account of transport difficulties and costs, it could not be grown profitably by those whose holdings are situated at any great distance from the ginning centres. I am therefore in favour of confining Sea Island to the districts between Ra and Nadi on the western coast where it can be dealt with at the Lautoka ginnery and there need be no fear of the two varieties being mixed.

With regard to the new variety (which can be picked twice as easily), Fijians, if given a little encouragement and training, should be quite capable of producing up to 500 bales in the districts of Nadroga and Colo West alone. Each year they are becoming more and more interested and it is encouraging to see that a number of them have been growing cotton for the last three seasons. In order to stimulate their interest it might be a good thing for the province to provide villages with agricultural implements on the understanding, or rather, written agreement, that the implements would be paid for from the proceeds of the crop at the end of the season. The time limit for payments might be extended over one or two seasons according to the area and yield of the crops concerned. Having firmly established cotton growing on this island we would be in a position to concentrate on some of the other islands.

An important fact which should not be lost sight of is that it is not advisable for a grower to depend upon cotton alone for his livelihood. It should be grown in conjunction with other crops and rotated with a legume. At present with perhaps the exception of tobacco, other than perishable crops, such as maize and tomatoes, there are not many being grown. In order to encourage the growing of them it would be advisable to extend the area of the Cotton Station and to make a general experiment station of it, where crops such as ginger, senna, turmerik, groundnuts and onions might be thoroughly tested and distributed to growers if found successful.

His Excellency.—I am sure we all appreciate Mr. Anson's interesting paper and I think, perhaps, that he has not gone far enough in explaining the steps he has taken for the practical application of his teaching to the Indians of the country. I fully endorse what he has said about agricultural implements. I know that Mr. Anson is proceeding on the lines I mentioned this morning. I agree that it is a good thing to put people on the land, to assist them with practical demonstration and to teach them how to rotate their crops. I think valuable work is being done in this direction. I invite discussion on Mr. Anson's paper.

Mr. Field.—I should like it to be clearly understood that the cotton industry is still in an experimental stage. It is now seven years since the revival of the industry; this may seem a long time. The reason for this protracted experimental stage, which should be completed in another two years, is on account of Sea Island cotton having been planted in the first place. This variety has the longest and finest staple that can be produced anywhere in the world, and on account of these qualities it is the most

expensive. The demand for this variety within the past seven years has been limited, and there was some difficulty in disposing of the small Fijian crop. It has been estimated that owing to the falling off in demand for this cotton, it might take as long as eighteen months to two years to dispose of a crop of 2,000 bales after delivery in the United Kingdom. The prices realised up to date for Sea Island cotton have been most profitable to all concerned. However, this has not altered the position and it is still considered to be an unsatisfactory variety to grow as there is the risk of the industry being "saddled" with large stocks of cotton unsold in the United Kingdom. The British Cotton Growing Association advises trying out other varieties and the selection of one that will suit the climatic conditions of Fiji, be remunerative to the grower, and for which there should be a regular demand. This naturally takes time as selection work and cross-breeding, even with the best of luck and under the most favourable conditions, can seldom be achieved in less than from five to six years. Owing to these experimental stages the industry has been more or less held in suspense, and in consequence the preparation, ginning and marketing of cotton in Fiji has been held back and it cannot be said to have reached an economical position from a commercial point of view. Nearly all varieties of cotton have their ginning peculiarities, that call for different types of ginning machinery. Until it has been definitely settled which variety is to be grown generally in Fiji and the crop reaches 1,000 bales, the ginning and preparation of the cotton for export will have to be carried on with the existing plant which is only suitable for Sea Island cotton, but can be made to gin other varieties, though not on commercial lines or on a profit-making basis.

[Mr. Field then described in detail the lay-out and method of operation of the two existing ginneries, one of which is at Lautoka, and the other at Sigatoka].

Mr. Tarby.—Indian cultivators in other islands of the Group are capable of producing cotton and many of them are anxious to do so. How long will it be before this crop can be extended to those places?

Mr. Anson.—We hope first to make a success in this island before dividing our forces. Increased overhead charges and expenditure which would be necessary would be disastrous to the industry at the present time. As soon as we have fixed our policy here and made a success of it, which will take two more years at the least, then we can extend to the other islands. There is really no reason why growers should not plant up on other islands, but the cost of getting the cotton to the ginnery would be greater than the profits reaped by the grower under present conditions.

Mr. Hunt.—What would be the possible return per acre for cotton. We have figures for certain varieties which returned £16 8s. 8d. and £18 13s. 9d. respectively.

Mr. Anson.—The average yield of the new variety would work out between 750 and 800 lb per acre. The average price received by the grower is 2½d. per lb and the return would be £7 or £8 per acre. That is for the new variety.

Mr. Hunt.—What would be the cost of production?

Mr. Anson.—At the Experiment Station the cost is probably a little on the high side. There it works out approximately £3 7s. 6d. per acre.

Mr. Hunt.—Is the cotton industry supported by the Government at present or is it running on its own merits?

Mr. Anson.—The industry is running entirely as a commercial concern at the present time. The prices have been fixed by Government. The

IMPORTS AND EXPORTS DURING THE YEARS 1923-1928.

Article.	Year 1923.		Year 1924.		Year 1925.		Year 1926.		Year 1927.		Year 1928.		Average for 6 years.		Percentage to total Imports and Exports		
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	1923. Value. %	1928. Value. %	Ave 6 ye Val %
TOTAL IMPORTS	...	£ 988,029	...	£ 1,065,874	...	£ 1,263,486	...	£ 1,464,177	...	£ 1,215,612	...	£ 1,455,090	...	£ 1,242,045	...	...	...
Rice*	206	3,269	658	10,992	149	2,449	2,390	38,448	757	10,837	1,218	18,994	896	14,165	0.33	1.31	...
Sharps*	3,194	32,591	3,695	35,618	3,475	40,564	4,010	51,143	4,210	47,549	4,050	47,575	3,772	42,507	3.28	3.27	...
Dhal*	112	1,342	180	2,199	281	3,939	286	4,518	283	4,078	354	5,781	249	3,643	0.14	0.40	...
Mustard Oil*	150	6,825	207	11,383	163	9,699	202	11,003	165	9,462	169	8,423	176	9,466	0.69	0.51	...
Ghee*	58	3,665	98	6,818	68	1,565	85	5,452	114	6,991	134	7,103	94	5,765	0.37	0.49	...
Spices*	17	800	19	1,204	17	1,207	25	1,190	14	695	23	1,574	19	1,111	0.08	0.11	...
Potatoes and Onions*	1,291	11,340	1,530	13,583	1,255	14,505	1,418	15,546	1,506	10,115	1,790	14,346	1,465	13,239	1.15	0.99	...
Total, Value ...	...	59,832	...	81,797	...	73,928	...	127,300	...	89,727	...	103,796	...	88,896	6.05	7.13	...
TOTAL EXPORTS	...	1,461,518	...	1,442,215	...	2,107,014	...	1,647,364	...	1,930,208	...	2,633,238	...	1,870,259	...	...	...
Sugar	44,108	866,287	44,470	768,110	91,744	1,371,267	56,991	808,195	72,752	1,125,215	120,683	1,827,095	71,791	1,127,695	59.27	69.39	...
Molasses	8,392	8,392	4,783	4,783	8,283	8,283	7,374	7,374	11,181	11,181	14,599	14,599	8,602	8,602	0.58	0.55	...
Copra	24,161	443,445	23,137	484,496	24,133	497,713	27,868	573,475	26,500	534,416	27,947	567,254	25,624	516,633	30.34	21.54	...
Coconuts	45	1,119	52	1,613	45	1,420	25	1,107	64	1,160	33	600	44	1,169	0.08	0.02	...
Coconut Oil	538	10,174	74	2,977	132	5,026	91	4,387	79	3,357	101	4,421	136	5,057	0.80	0.17	...
Bananas	8,132	94,325	9,357	115,246	11,312	132,491	11,288	138,040	10,884	157,819	10,432	147,781	10,232	130,950	6.45	5.61	...
Cotton	15	...	28	...	22	...	147	...	64	...	25	...	50	...	...	...	...
Cotton—Output at Factory ..	...	3,530	...	9,255	...	5,128	...	32,134	...	13,733	...	4,742	...	11,420	0.24	0.18	...
Cotton Seed	43	...	83	...	66	...	419	...	190	...	58	...	143	...	...	...	...
Rubber	40	5,128	71	7,416	64	16,116	114	23,581	99	15,276	42	4,704	70	12,042	0.35	0.18	...
Pineapple (fresh)	174	2,088	129	1,408	264	3,665	269	3,277	190	2,124	153	1,703	196	2,397	0.14	0.07	...
Mauritius Beans	...	...	62	2,192	63	1,807	42	1,201	168	4,924	111	1,567	(5 years) 89	2,338	...	0.06	...
Maize	...	...	6	47	55	348	41	271	69	416	...	...	43	270	...	...	...
Vegetables	192	2,529	294	2,572	242	3,171	525	4,958	361	3,717	457	6,169	348	3,852	0.17	0.23	...
Biscuits	51	2,604	149	7,788	215	10,429	202	9,095	168	9,334	195	11,306	163	8,426	0.18	0.43	...
Butter	...	...	...	...	10	1,881	26	3,616	24	3,615	15	2,269	19	2,670	...	0.09	...
Various (value)	...	25,427	...	36,391	...	52,437	...	50,707	...	38,581	...	38,221	...	40,294	1.74	1.50	...

* Principal Indian foodstuffs.

Imports and Exports.			Imports and Exports in 1928 compared to Imports and Exports.				Percentage in terms of weight and value Imports and Exports in 1928 compared to Imports and Exports in								Ratio of Imports and Exports (in groups) to total Imports and Exports.					
1923.	In 1928.	Average of 6 years.	1923 Season.		Average of 6 years.		1923 Season.				Average of 6 years.				1923 Season.		1923 Season.		Average of 6 years.	
			Increase Per cent.	Decrease Per cent.	Increase Per cent.	Decrease Per cent.	Increase.		Decrease.		Increase.		Decrease.		Per cent.	Value. £	Per cent.	Value. £	Per cent.	Value. £
							Tons.	Value. £	Tons.	Value. £	Tons.	Value. £	Tons.	Value. £						
Imports of Principal Indian Foodstuffs—Total Imports: 1923, £988,029; 1928, £1,455,090; and average of 6 years, £1,242,045.																				
206	1,218	896	491.26	...	35.94	...	1,012	15,725	...	...	322	4,829	...	...	} 6.05	59,832	7.13	103,796	7.24	89,896
194	4,050	3,772	26.80	...	7.37	...	856	14,984	...	...	288	5,068	...	...						
112	354	249	216.00	...	42.17	...	242	4,439	...	...	105	2,138	...	...						
150	169	176	12.66	...	...	3.97	...	19	1,598	...	...	...	7	1,043						
58	134	94	131.03	...	42.55	...	76	3,438	...	...	40	1,338	...	...						
17	23	19	35.29	...	...	...	6	774	...	...	4	463	...	...						
291	1,790	1,465	38.65	...	22.18	...	499	3,006	...	...	325	1,107	...	...						
Exports (production)—Total Exports: 1923, £1,461,518; 1928, £2,633,238; and average of 6 years, £1,870,259.																				
Industries controlled and worked by Europeans, Natives and Chinese with practically no assistance from Indians (a very few labourers only).																				
427	38,221	40,294	50.31	...	5.02	...	12,794	...	...	...	...	2,073	...	...	} 2.89	40,734	2.42	61,386	3.22	60,299
51	195	163	282.35	...	19.61	...	144	7,243	...	...	32	1,609	...	...						
10	15	19	50.00	...	...	21.00	5	702	...	...	...	4	562							
338	101	136	...	70.71	...	25.76	...	237	8,812	...	...	35	1,310							
192	457	348	138.02	...	23.85	...	265	2,932	...	...	109	1,206	...	...						
Industries controlled and worked by Europeans, Natives and Chinese with very small assistance from Indians (a few labourers only).																				
164	27,947	25,624	15.73	...	9.07	...	3,786	76,101	...	...	2,323	46,721	...	...	} 36.87	538,889	27.24	717,202	34.81	651,090
45	33	44	...	26.66	...	25.00	...	12	319	...	...	11	292							
132	10,432	10,232	28.16	...	1.85	...	2,300	29,305	...	...	200	2,550	...	...						
24)	(5 years)	89	79.00	...	24.72	...	49	1,211	...	...	22	682	...	...						
62	111	89	79.00	...	24.72	...	49	1,211	...	...	22	682	...	...						
Industries under full control of Europeans and almost entirely assisted by Indians (growers and labourers).																				
108	120,688	71,791	173.60	...	63.00	...	76,575	1,221,473	...	...	48,892	774,938	...	...	} 60.20	879,807	70.12	1,846,392	61.40	1,148,339
392	14,599	8,602	74.00	...	69.72	...	6,206	6,206	...	...	5,997	5,997	...	...						
40	42	70	5.00	...	...	40.00	2	280	...	...	...	28	3,900							
Industries controlled and worked entirely by Indians with slight assistance (manufacturing and shipping, &c.,) from Europeans.																				
15	25	50	66.66	...	...	50.00	10	1,212	...	...	...	25	6,678	...	} 0.39	5,618	0.27	6,441	0.75	14,067
43	58	143	34.88	...	...	59.55	14	49	...	...	...	86	301							
174	153	196	...	12.00	...	21.94	...	...	21	256	...	43	526							
24)	(1927)	(4 years)	...	...	...	...	...	...	...	...	...	...	...							
6	69	43	76.81	...	...	100.00	...	...	6	60	...	43	270							
794	7,966	8,590	...	18.66	...	7.26	...	...	1,868	28,954	...	...	864	13,694	} Non Export—Grown and consumed locally.					
263	21	125	...	92.00	...	83.20	...	...	242	2,904	...	...	104	1,518						

prices for Sea Island are 4d., 3d., 2d. and 1d. per lb; the prices for the new variety are 3½d., 2d. and 1d. per lb.

His Excellency.—*I understand that the Government gives a fixed price for the cotton. What is the Government's position when it has sold the cotton?*

Mr. Field.—The Government purchases the cotton from the growers at approximately 75 per cent. of its estimated value. After the cotton has been sold and Sales Accounts come through, and all costs have been deducted, the balance is distributed to the growers. I think what Mr. Hunt wanted to know is whether the Government subsidises the cotton industry: The industry is run entirely without Government financial assistance, although I believe the Government gave a grant of £700 at the beginning of the enterprise. Last year there was a loss of £513 which is the first loss since the industry commenced. There was a profit of £8,000 for the 1926-27 crop, when 919 bales were shipped. This profit was distributed as a deferred payment; nothing was placed to a reserve and the cultivators derived the maximum benefit.

Mr. Turbet.—The cultivation of cotton is important from the point of view of obtaining cotton seed for concentrated food for cattle. Mr. Anson states that one company has taken ten tons of seed and are very satisfied with the results. In 1928 I undertook some cattle feeding experiments in Suva with cotton seed and I found that all the animals did well on it. I think cotton seed is a valuable additional food for working stock. I do not know what has been done in the way of endeavouring to crush the cotton seed for the extraction of oil and the manufacture of cotton seed meal.

Mr. Barnes.—The remarks of Mr. Turbet are very interesting, calling attention as they do to the value of cotton seed for cattle food. I would refer him to recent work in America where experiments have been carried out in this connection. With regard to the crushing of cotton seed, one farmer in Suva recently endeavoured to get cotton seed crushed at the local oil mill, but unfortunately they were unable to take the work. Their machinery is adapted for special purposes and an experiment of that nature would disorganise certain sections which is hardly an economical proposition from their point of view. If a steady supply were assured the necessary arrangements could probably be made.

His Excellency the Governor.—*I will now request Mr. Stuchbery to read a paper on the Dairy Industry.*

PROGRESS OF THE DAIRYING INDUSTRY IN FIJI.

By H. M. STUCHBERY, B.V.Sc., Acting Senior Veterinary Officer.

It is now about seven years since the dairying industry was established in Fiji and a review of the progress made during this period may be of interest. It is intended to confine attention chiefly to the progress made in regard to the class of cattle among those herds supplying butter-fat to the three factories, Tailevu, Rewa and Navua, and to the general methods of management by dairymen. It must be borne in mind that there are besides these herds many other herds concerned in the production of milk and butter in which much improvement has taken place, although not perhaps to the same extent as has occurred in those herds supplying these factories. Before the Tailevu dairy scheme was started very few pure-bred stock of a milking strain existed in the Colony. The following figures give a fairly accurate summary of the state of these herds to-day:—

		Tailevu.	Rewa.	Navua.
Number of herds supplying cream to factory	.. ..	23	15	14
Number of herds using pure-bred bulls	.. ..	10	15	9
Number of herds containing pure-bred cows	.. ..	..	11	4
Number of years factory has been established	.. ..	7	5½	4

It is safe to say that 90 per cent. of the remainder of the herds use good grade bulls as sires. Generally speaking, too, it is only the small suppliers who are not making use of pure-bred sires. A statement to the effect that in no other Colony would we find such a large proportion of pure-bred stock would be difficult to contradict. It must be remembered also that there are other breeders of pure-bred stock in Fiji who are not included in these figures.

When considering the progress being made in the dairying industry, sight must not be lost of the fact that at the outset these herds were built up hurriedly from whatever stock was available. While many of these may have been quite suitable for the purpose, a great number coming as they did from untried stock, must have been entirely unsuitable and unprofitable. It has fallen to the owner therefore to eliminate these unprofitable cows from his herd, a task which takes years to do in many cases on account of lack of capital and difficulty in obtaining good cows to replace the unsuitable cows. The following figures of the production of cows in the Rewa area may be of interest. These were supplied by the Manager of the Rewa butter factory. These figures were obtained from cows whose morning and evening milk was weighed, sampled and tested:—

30 cows yielded over 50 lb butter-fat in 30 days.					
10	do.	40 lb	and under	50 lb	in thirty days.
76	do.	30 lb	do.	40 lb	do.
289	do.	20 lb	do.	30 lb	do.
141	do.	12 lb	do.	20 lb	do.
10	do.	under	12 lb	..	do.

It will be seen that in the Rewa there are still a large number of unprofitable cows in the herds. These figures are taken whilst the cows were in full milk so that their average yield per month for their full milking period would be considerably below this figure. It can be taken for granted therefore that any cow showing a lower production than 20 lb per month in these tests is unprofitable. The same proportion of unprofitable cows would also exist in the Tailevu and Navua districts. It might be said that such a proportion of unprofitable cows does not reflect creditably upon the owners, but several facts must be borne in mind, namely:—

- (1) owners have not yet had time to cull their herds sufficiently;
- (2) it is difficult for these owners to avail themselves of a subsidiary industry while their herds are being built up;
- (3) it is better to have even a bad cow producing a small quantity of butter-fat than to have no production at all.

Dairymen on the whole are quite aware that a number of unprofitable cows do exist in their herds and they are fully alive to increase in profit which could be made with better cows. From the herds of such owners we can expect an increasing yield per cow in the future.

In the dairying industry an important step towards success is supplementary feeding with concentrated foods. Where pastures are of a high nutritious value this factor is not of such vital importance. Whilst pastures are very prolific in our dairying areas in Fiji, it cannot be denied that they are rather low in nutrient value, and hand-feeding foods is sure to be beneficial. In Fiji the supplementary foods obtainable at a reasonable cost are rather limited. The only concentrates at present in

use are coconut meal, rice bran and molasses. Quite a number of dairymen are using these with beneficial results and the number of these users is bound to increase when the benefits obtained from the use of these foods become more widely known, and it would appear that secondary industries producing concentrated stock foods as by-products should find a ready sale for these. At present difficulties of transport and the cost of same, place some dairymen at a disadvantage in the use of these foods, but time will lessen these problems.

In most dairying countries, supplementary industries to the production of butter-fat are an important part of the dairying industry. Up to the present, dairymen in Fiji have not developed this section of the industry to any great extent, the rearing of young stock for butchers purposes being practically the only sideline to the industry. The raising of swine for local butchers purposes offers a good field of investment as between 60 and 70 pigs are imported each month for this purpose. A praiseworthy effort is being made by the Fiji Pastoral Company Limited to capture this market, and up-to-date piggeries have been constructed to provide for the breeding of pigs on a large scale. The Suva butchers are anxious to obtain locally-bred pigs as it will not be necessary for them to retain such a large number of pigs at their yards against the next shipment from overseas. At present, however, it would never do for all our dairymen to go into the pig raising industry as the supply would soon exceed the demand. The production of bacon in connection with dairying industry is, however, a source of great profit and the establishment of a bacon curing factory is within the bounds of possibility if our dairying industry continues to expand. The establishment of any industry which will absorb by-products of the dairy industry is sure to benefit and stimulate the dairying industry considerably.

While it is apparent that good work has been done by the pioneers of the dairying industry, often under adverse circumstances, we must not lose sight of the fact that much can still be done to make the dairying industry more productive and profitable. The following points commend themselves for consideration in the future of the industry:—

- (1) more extensive testing of dairy heads with subsequent elimination of unprofitable cows;
- (2) the improvement of pastures by the elimination of weeds and pests, and the introduction of nutritious fodder plants;
- (3) a wider adoption of the principles of handfeeding with concentrated foods;
- (4) the development of secondary industries which will benefit the dairying industry;
- (5) the adoption of the most up-to-date methods of handling of dairy produce with the strictest attention to all sanitary precautions, necessary for the production of only the purest dairy products.

The successful adoption of all these measures does not lie entirely with the dairymen, and any assistance that can be given to this body of men will ultimately reflect on the prosperity of the Colony.

Butter Production in Fiji.—The following figures taken from the Fiji "Blue Book" give the butter production from the butter factories since 1921:—

Year.	Amount.	Year.	Amount.
1921	15,104 lb	1925	168,844 lb
1922	23,785 lb	1927	302,513 lb
1923	59,219 lb	1928	313,655 lb
1924	143,219 lb	1929 (estimated)	357,000 lb

The 1929 figures are estimated from the production of one factory for 1929 compared with the previous year. It will be noted that there has been a constant and rapid increase in the production of butter every year. The increase in 1928 was certainly only slight, but it must be remembered that the latter half of 1928 was exceedingly dry, and the butter-fat production decreased accordingly.

His Excellency the Governor.—*I congratulate Mr. Stuchbery on his interesting paper relating to this important industry. I think the figures which he quoted make most heartening reading. When I was in London I was told that the Fiji butter was just as good as the best New Zealand butter.*

Mr. Turbet.—In opening the discussion on Mr. Stuchbery's paper I would first of all like to compliment him on the able manner in which he has reviewed the dairying industry. Fortunately, I have had an opportunity of reviewing his paper. Although it is not lengthy it has the advantage of covering the ground concisely and giving a good lead in the concluding points for a discussion as to the best methods of fostering and improving the industry. Let us consider Mr. Stuchbery's points.

The first is, "A more extensive testing of dairy herds with subsequent elimination of unprofitable cows." The testing here referred to is the recording of the daily and total yield in milk and butter-fat for each cow over a given period, which might be a month or the usual milking period, about 273 days, or a whole year. An accurate record of these returns enables the farmer to ascertain the relative economic values of his cows. Where concentrated feeding is resorted to it can be ascertained whether the cows are giving a fair return for the value of the concentrates used. In the breeding of dairy cattle also, the returns of the cow as revealed by the herd tester give a most accurate guide for the selection of the most profitable animals. In these times when it is hardly the practice to rear all calves born on the farm, those heifer calves, at least, of known high producers should be raised with extra care as on those animals depends the future herd. In larger countries than Fiji it is usual to employ herd testers, either by the Government or by Herd Testing Association. Such an appointment may not be warranted here yet, but good work in that direction is being done by the managers of the butter factories.

The second point is, "The improvement of pastures by the elimination of weeds, pests and the introduction of nutritious fodder plants." If I were to be asked what is the greatest enemy of agriculture and the live stock industry in Fiji? I would reply, "The rapid growth of noxious weeds." I need not dwell on that; the curse of noxious weeds is too well known to all present. Apart from control of weed pests by biological means the only solution to the problem seems to be in limiting the size of the holding to such dimensions that it is within the power of the occupier, either financially or physically, to cope with the annual crop of weeds. Once having cleared his holding of weeds, weeding must be considered as a periodically recurring event in the routine of the farm and in preparing the estimates funds must be provided for that work. The only means of checking weed growth on Fijian-owned land and on large holdings such as Vitilevu Bay, once the weeds invade the district, is by keeping as much of the country as possible covered with the virgin vegetation of the region. Only such areas as can be kept in control should be used. It seems to me of little use experimenting further with grasses and fodder plants of temperate zones. That has been done for decades and I think it can be safely

assumed that all those which will grow are already here. It is in the other milder tropical countries that we should search for such plants. Older established and well-organised tropical countries such as Jamaica, Hawaii and the Philippines no doubt contain many useful fodder plants suitable to our climate which have not yet been introduced here.

The third point is, "A wider adoption of the principles of hand-feeding with concentrated feeds." The concentrates available in Fiji are:—Rice Bran, Coconut Meal and Cotton Seed. Rice bran and coconut meal have been well tried and those dairy farmers who use these concentrates are awake to the increased yield of milk and greater profits which accrue from their use. I have recently had an opportunity of visiting many dairy farms in Australia. I found that all dairies in the vicinity of Sydney are relying solely on hand-feeding, whilst in the country districts many farmers are feeding at least a ration of concentrates. Nearly every farm of any consequence has also installed one or more silos. In this country where it is impossible to store feed as hay I think that the silo offers the best means of storing the better classes of bulk feed or roughage for winter feeding. Maize has been found excellent for silage purposes, but most grasses and herbage can be used. The feeding value of silage is high and it enables dairy cows to produce milk and butter-fat more abundantly. It is estimated also that the use of silage will increase the carrying capacity of a dairy farm by about 25 per cent. The cost of construction is considerable as probably only the tub silo would be efficient in the country. Before recommending their general construction I think that one should be built experimentally. That is a matter which could be gone into further. A feeding experiment with local cotton seed was conducted a few years ago. There is a record of that in the department. The results showed that there was no harmful effect from the feeding of the seed and the animals certainly improved in condition and growth as compared with the control. The matter of crushing the seed locally was gone into, but, I think, found too expensive; however, the whole seed offers a further choice of concentrated feed for our dairy stock. Those who do not feed supplementarily with concentrates should be guided by the experiences of those who do. No doubt there are some present who have had experience.

The fourth point is, "The development of secondary industries which will benefit the dairying industry." Our local dairy farmers have always been under a disadvantage in making their farms pay, as compared with similar farms in other countries. In those other dairying countries there are well-established secondary industries which help to augment the returns of the farm. Chief among these industries is pig raising. It would appear that there is no farmer or body of farmers in Fiji who can guarantee to the butchers a regular monthly or periodic supply of uniform healthy pigs. If that supply existed I am sure that butchers would purchase locally instead of importing. In other words the industry is not organised here. We have abundant feed suitable for pigs in Fiji among which might be mentioned, skimmed milk, maize, rice bran, coconut meal, broken rice, grasses and root crops. That is a fair selection. There is not time to go into the whole business of pig raising now, but I have no doubt that it can be profitably conducted in Fiji. The Veterinary Division is always prepared to advise from personal experience and from literature which is available in the Department. Bacon curing might also be considered as an extension of the pig raising industry. Skimmed milk enters extensively into the manufacture of margarine. The other ingredients of margarine are also produced in the Colony, such as fats and oils. There should be a good

market for the product in Fiji among our Indian community. Another consideration is the coagulation of the casein of skimmed milk, the drying of the same and its export. It is a valuable commodity and is used in the manufacture of many articles. The poultry yard and the banana plot are also valuable adjuncts to the dairy farm.

Mr. Witherow.—I would like to point out that coconut meal is unprocureable in Fiji. The Rewa dairymen were using about ten tons every month and suddenly the supply came to an end. Then there is the question of top dressing in Fiji. Fodder plants in Fiji grow very quickly compared with other countries where it is colder, and I think that this makes the nutritive quality in the grass less here.

Mr. Turbet.—There is no doubt that what Mr. Witherow says is correct, but there is the question of stock licks which is an alternative method of providing the extra chemicals required. We have always recommended stock licks and in co-operation with our Government Chemist we will now be able to ascertain the composition of our fodders and find which chemicals are lacking.

Mr. Hunt.—With regard to the dairying industry in Fiji there is no doubt that you can appreciate the benefit of that industry to Fiji when in seven years there is an increase from 15,000 pounds of butter to 318,000 pounds. I think I am speaking for all the suppliers and the men who are in the dairying industry, and I may say that we quite appreciate all our faults. We also appreciate what standard we can rise to, but in the majority of instances it is a matter that the exchequer controls. The heavy expense of keeping down noxious weeds is a serious handicap. [Mr. Hunt then referred to the Dairy Regulations drawn up by the Medical Officer of Health]. I hope that Your Excellency will afford the dairying industry every possible assistance.

Mr. Barnes.—Perhaps I may be permitted to deal with some of the questions just raised. Regarding the subject of noxious weeds, information has been received from Mr. Simmonds that he will be ready to leave Trinidad with a consignment of the Thrips by the direct steamer which sails from London on 5th February. He will be joining that steamer at Balboa and should reach here about the middle of March. Arrangements have been made for Mr. Taylor to return in time from Java to take over from Mr. Simmonds the work of introducing the Thrips. The old Government Experiment Station at Nasinu will provide an ample supply of the weed *Clidemia hirta* (Koster's Curse) on which to try out the Thrips when they arrive from Trinidad.

In regard to experiments with fodders and top dressings I may say that a small experiment is already in hand and that the Department will publish the results as soon as available.

The local manufacture of margarine has engaged my attention for some little time, since the question of supply to the Indian community of ghee came under consideration. This is a very expensive commodity and costs probably more than butter. It is in fact almost pure butter-fat whereas butter contains a proportion of water. If we can persuade the local Indians to use margarine in place of ghee it will mean the building up of a valuable secondary industry.

In regard to the stoppage of supply of coconut meal I was not previously aware of the fact that it was not locally available and that certain dairymen were anxious to procure it. I can assure interested people that steps will be taken to try to remedy this.

His Excellency the Governor adjourned the Conference until 2.15 p.m.

Conference resumed at 2.15 p.m.

His Excellency the Governor.—We will now continue the discussion on the dairying paper.

Mr. Blackie.—Mr. Stuchbery stated there is a marked improvement in the dairying industry, but I would like to point out that since assuming my duties as Government Analyst I have analysed 40 samples of milk, 60 per cent. of which were deficient in fat and solids not fat. Although undoubtedly many of these were adulterated, yet even the milk from dairies properly controlled, although conforming to Fiji requirements, which are of a fairly low standard, are not equal in my opinion to milk values obtained in New Zealand and Australia. Even two samples from pure-bred Jersey cows gave fat values lower than is usual for this breed.

Mr. Turbet.—The quality of milk is fixed for any particular cow, irrespective of what food she gets. What is altered is the total quantity of milk produced by the cow. In spite of this, however, the quality of milk varies according to the period which has elapsed since calving. It is difficult to explain why there should be a deficiency in any particular pure-bred Jersey cow.

Mr. Barnes.—This question was asked by Mr. Blackie at my suggestion. It is obvious that the quality of milk which is being supplied for public consumption in Suva at the present time is, in some cases, inferior, and it was thought that this would be a convenient opportunity to ventilate the question. Samples have been taken at the time of milking and brought to the laboratory under proper care. It was found that European dairies, which were carefully looked after, had a much higher fat content than the milk supplied by Indian dairies in Suva, where it is obvious that they do not receive attention that is demanded for a dairy supplying milk for public consumption. This is a most important matter from the public health point of view. If the figures which Mr. Blackie obtained are typical of the majority of milk that is available for human consumption then there is a possibility that the standard should be reconsidered. In my opinion the standard is already sufficiently low and it should be possible to maintain a much higher average content of fat.

Mr. Kiss.—Spoke about tests of cows varying at different times.

Mr. Stuchbery.—It is possible that something happened to the animal referred to to make it give a low test on one occasion. It was perhaps frightened by another cow before going into the bail, or it did not yield all its milk.

Mr. Barnes.—I would like Mr. Leaning to give his views on this question.

Mr. Leaning.—Referring to the question of testing, experience in New Zealand over a number of years shows that the testing of a cow once a month gives figures that agree fairly closely with the butter-fat return from the factory. In Fiji we have carried out a series of tests and I am very doubtful whether the average fat production per cow amounts to more than about 90 lb a year. This is very low indeed. Last month we had a record output for our Tailevu factory and the net production per cow worked out at 15.2 lb of butter-fat, which is representative of the whole. An article published by a Herd Testing Association in New Zealand showed that there was one herd of 76 cows produced 67 lb butter-fat per cow during the month, and the lowest yielding herd in the Association produced 18 lb. It was a herd of 37 cows and that shows that their lowest herd is equal to our best herds at Tailevu. This indicates that we should go in for testing more extensively than has been done in the past. We have offered the suppliers an excellent scheme. It is costing them nothing. All they

have to do is to take the samples and bring them to the factory where they will be tested free of charge. I have written to the Department of Agriculture in New Zealand, and the Director of the Dairy Division asking for all available information in connection with testing. When received this will be at the disposal of the farmers. Another point was raised this morning which I personally think is a good scheme. When I was in New Zealand I showed Dr. Thompson's Regulations to one of the prominent men in the dairy industry there and the only fault he could find with them was that they were not strong enough. Of course, they can be amended and brought up-to-date. The appointment of a Dairy Instructor is essential and it would assist the farmers in this way. It would be one of his jobs, if we were making second-grade butter, to go to the farmer and put him right. It might be his separator at fault. I tested a man's separator last week and I found that he was losing at the rate of £7 per month. No one in the dairying industry in Fiji can afford to lose £7 per month. It is unfortunate that some of the suppliers think the time is not yet ripe for the appointment of a Dairy Instructor. At the present time we are producing more butter than the local market can consume and if we want to compete with other countries we have to put a decent article on the market. It is no use our going ahead and sending away second-grade butter and trying to sell it against New Zealand butter which is equal to the Danish article. I think these matters should be gone into and the farmers should agree as a body to employ highly skilled men which will pay them in the long run.

Mr. Turbet.—In my opinion the cows supplying milk for local consumption do not compare with those supplying butter-fat because the land in the immediate vicinity of Suva does not appear to be suitable for pasturage. It would be much better if these dairies were moved from Suva into the country, say the Rewa valley.

Mr. Ginn.—I take it I am the largest individual supplier in Suva. I represent the Suva Milk Supply Company. I have sold milk for many years and I claim that the test of my milk is equal to the test of specially selected Jersey cows. My only difficulty is to get the quantity of milk. I am quite satisfied with the quality.

Mr. Hunt.—When dairy farming in Tailevu I found that 2.45 gallons of milk were required to make a pound of butter, whereas in Suva milk was sold for 6d. a quart. The Tailevu settlers are on a better wicket than the Rewa suppliers because the former place only required 2.45 gallons of milk per pound of butter, whereas the latter required 2.85 gallons.

His Excellency the Governor.—*It may be that an example of hand-feeding which came under my personal notice in Hong Kong will be of interest. One large dairy there with several hundreds of head of cattle depended entirely on hand feeding. There was no pasturage at all and the cattle were only turned loose for exercise.*

Mr. Barnes.—Summarising some of the salient points of Mr. Stuchbery's paper, together with those introduced by Mr. Turbet and those which have been brought forward by the members in the body of the hall, I am pleased to see the keen interest that has been taken and the very useful information that has come to light in the course of discussion. The main points of Mr. Stuchbery's paper are that the dairy industry is now firmly established as an agricultural industry of Fiji, that it has grown in seven or eight years to take its place among the more important agricultural industries, but there still remains much to be done. It has been admitted that we do not know sufficient about the feeding requirements of our animals. The

present discussion will be of great help to the Department, indicating as it does the lines of inquiry to be followed. We must all combine and work in close co-operation for the improvement of this important industry to the Colony.

His Excellency the Governor.—The next paper to be read is on the subject of Coconut Oil and Copra by Mr. Barnes.

COCONUT OIL AND COPRA.

By A. C. BARNES, F.I.C., B.Sc., A.M.I.Ch.E., Superintendent of Agriculture.

Vegetable Oils.—Vegetable oils are amongst the most interesting and valuable substances produced by plant life. Oil is found in the fruit, flowers, leaves and stems of many plants and the oils themselves are as diverse in characteristics and uses as the plants from which they are obtained. Some of the oils, known as volatile or essential oils, find a use in the manufacture of perfumery and flavouring essences. Others provide valuable human and animal food and still more find employment in the manufacture of soap and in the paint and varnish industries.

Coconut Oil.—From the point of view of the Colony of Fiji, the most important vegetable oil is coconut oil produced from copra, with which we are all familiar. Coconut oil is a vegetable fat and belongs to the non-volatile class of vegetable oils, or as they are sometimes known, fixed oils. They are used in both the edible oil and the soap industries. Coconut oil essentially consists of a combination of certain so-called fatty acids with glycerine in the forms chemically known as glycerines.

Fatty Acids.—The fatty acids themselves are interesting chemical compounds, ranging from formic acid, commonly occurring in the animal world as the irritant liquid secreted by ants, bees, wasps, and in the vegetable world occurring in the common nettle and other stinging plants. The next in that series* is acetic acid, familiar on the table in the form of a diluted solution known as vinegar. Much higher up in the series we come to palmitic acid which is a white solid at ordinary temperatures and is largely used in the manufacture of candles. Palmitic acid occurs combined with glycerine in many vegetable oils, but principally in palm oil which is the produce of the oil palm (*Elaeis guineensis*) examples of which will be found in the Botanical Gardens, Suva. Glycerine is a substance with which we are all familiar. It is a heavy water white liquid used largely in the explosive industry and in medicine. Glycerine to a large extent influences the market price of vegetable oils during war time owing to its use in the manufacture of high explosives.

Alcohols.—Glycerine is a member of the alcohol series of compounds and is distantly related to the commonly occurring ethyl alcohol which we know in potable liquors like whisky, gin, brandy, &c. Alcohols are capable of combining with fatty acids to form substances known as esters. Thus, for example, amyl acetate, a pleasant smelling liquid, is formed by the union of amyl alcohol and acetic acid. This may be familiar to some of us by reason of the fact that it is largely used as a cement for celluloid. In these cases one molecule of the alcohol is capable of combining with one molecule of the acid because the alcohol has only one hydroxyl radical. Ethyl alcohol and amyl alcohol are monohydric alcohols. Glycerine, or to give it its correct name, glycerol, is a trihydric alcohol, that is, it has three hydroxyl radicals and is capable of union with three molecules of

* Actually there are five distinct series of fatty acids.

fatty acid. The resulting compound is known as a triglyceride. It has already been mentioned that when the union of an alcohol with a fatty acid takes place water is eliminated. Conversely the addition of water by special means to the ester or the compound of the acid and alcohol will split it up yielding as a result the original alcohol and acid as separate substances. This process, the breaking down of an ester into its component parts, is known as hydrolysis and is of great importance in connection with vegetable oils. It is in fact the basis of the soap industry.

Coconut oil, as we know it, is a clear pale yellowish liquid which will, however, solidify if the temperature falls below 24.5°C . Although it is a stable compound,* that is, a compound which is not easily broken down into its constituent parts, it is, nevertheless, susceptible to the action of chemicals and ferments, which break it down into fatty acids on the one hand and glycerine on the other. The process of hydrolysis, which is in effect, the addition of the elements of water to the oil, followed by the subsequent breaking up of the compound into the two parts already mentioned can be carried out quite readily. It is this comparative ease with which certain vegetable oils can be decomposed that renders it so necessary to prepare the raw material from which the oil is obtained with the greatest possible degree of care, always having in mind the exclusion of those factors which will tend to break down the oil and so reduce its market value.

Coconut oil in its pure state is neutral, that is to say, the whole of the fatty acids are in a state of combination with glycerine and the manufacturer of edible oil requires that the raw material, that is, the copra from which oil is expressed shall yield products as nearly neutral as possible. The soap manufacturer, however, is not so particular, more especially at the present time when glycerine is a drug on the market. What he requires are fatty acids which he can saponify by treatment with alkalis to form soap. In its natural state in copra the oil is much more readily decomposed than after it has been extracted by expression of the dried kernel of the coconut. From the time when the nut is first split until the dried copra reaches the oil mill it is liable to progressive decomposition if not carefully handled at every stage of its preparation and transport.

Decomposition of vegetable oils.—In certain vegetable oil bearing fruits such as the fruit of the oil palm the agencies which effect the decomposition of the oil are actually present in the fruit. Palm oil as it occurs in undamaged fresh fruit of the tree is neutral, but as soon as the fruit is bruised the oil cells in the vicinity of the bruise are ruptured and the oil comes in contact with what is known as an enzyme, which is the active principle of a ferment, and is immediately hydrolysed or transformed, by addition of the elements of water, into fatty acids and glycerine in their uncombined states. In the case of copra no such agency is present in the kernel and such decomposition of the oil as occurs is invariably the result of some introduced condition caused by careless handling and manufacture of the copra or exposure of the copra to the actions of enzymes or ferments from other sources. Apart from the disruptive action, as we may call it, of these enzymes water itself without any other assistance will very slowly cause the decomposition of certain vegetable oils. The presence of water is actually an absolute necessity for the process of hydrolysis to go on. This process, however, is greatly accelerated by the presence of the agencies already referred to, known as enzymes.

Effect of Moulds.—The common moulds which so readily grow on the surface of copra under damp conditions are fruitful sources of fat-splitting

* More correctly a mixture of compounds as it is a mixture of glycerides of several fatty acids.

enzymes. The damp surface of green copra forms an ideal developing ground for the innumerable spores of moulds which occur in the air having been derived from mature mould growths. Although the moulds develop comparatively rapidly they do take an appreciable time to reach a stage where their products are capable of decomposing the oil and their action in the early stages is entirely superficial. If, however, the green copra* is left undried in heaps mould growths develop with great rapidity and the infection spreads throughout the whole mass which quickly becomes a stinking heap of decomposed oily vegetable matter.

Rancidity.—A secondary action occurs after the original hydrolysis has commenced, resulting in the condition known as rancidity. Rancidity and the presence of free fatty acids in vegetable oils are often confused and it should be understood that although the one is a consequence of the other there is no similarity between the products which give rise to the two conditions. Rancidity is the result of the subsequent breaking down of the fatty acids liberated by hydrolysis under the action of moisture and air. The products formed are objectionable in flavour and odour and often give rise to considerable trouble in purifying the oil subsequently expressed from the copra. Highly rancid copra cannot be satisfactorily used in the edible oil industry. It is thus clear that the preparation of copra of good quality involves the careful exclusion of all conditions which will encourage the hydrolysis of the oil and the development of rancidity. The only way to do this is to dry the freshly cut green copra as rapidly as possible either in the sun or in a properly constructed and effective artificial drier. Green copra when freshly cut contains some 65 per cent. of water which must be reduced as quickly as is compatible with good quality of copra to somewhere in the neighbourhood of 5 per cent. if the product is to be free from more than a trace of free fatty acid. Though sun drying under ideal conditions is the best method of preparing high grade copra such a quality of copra can be obtained by artificial methods.

Drying.—The removal of moisture from vegetable matter in order to give a satisfactory grade of resulting product is not, however, so simple a matter as it would appear. Temperature conditions must be very carefully controlled, for if the drying copra is overheated chemical changes take place in the meat and the result is an inferior grade of product. Under no circumstances should the temperature be allowed to exceed 70° C. (158°F.) in the early stages of the drying. Overheating in the early stages of copra drying results in case hardening and moisture from the interior of the meat is prevented from diffusing as rapidly as it should to the outside layers, so that the copra appears to be dry when actually it is not. Such copra deteriorates seriously during storage and the shrinkage is of course, very high. By shrinkage is meant the loss of weight caused by evaporation of moisture. To illustrate the effect of over-heating vegetable matter in order to dry it rapidly we may consider the case of cane sugar which as is well known caramelises and turns brown when heated to a certain temperature. Starches and proteins undergo decomposition under the influence of heat and green copra which contains all these substances may be badly affected from over-heating during drying. In the design of kilns and hot air driers it is therefore necessary carefully to consider the question of temperature control.

Rate of drying.—The rate of loss of moisture from the drying copra is only partially dependent upon the temperature. Other important factors are the humidity of the air passing through the drier or over the drying

* The term "green copra" is used to denote the fresh kernel of the mature coconut.

copra and the rate of movement of the air current. Artificial driers for copra are familiar to most of us in Fiji. They are of several types, but in all of them the object is the same, that is, the removal as rapidly and as efficiently as possible of the excess moisture from the green copra. Involved in the question of efficiency is the quantity of fuel required to dry a given weight of copra, and it is here that there is still ample opportunity for research. Cartage of fuel to the drier is an expensive matter and when the husks of the coconut have to be supplemented by cut wood fuel artificial drying becomes very costly.

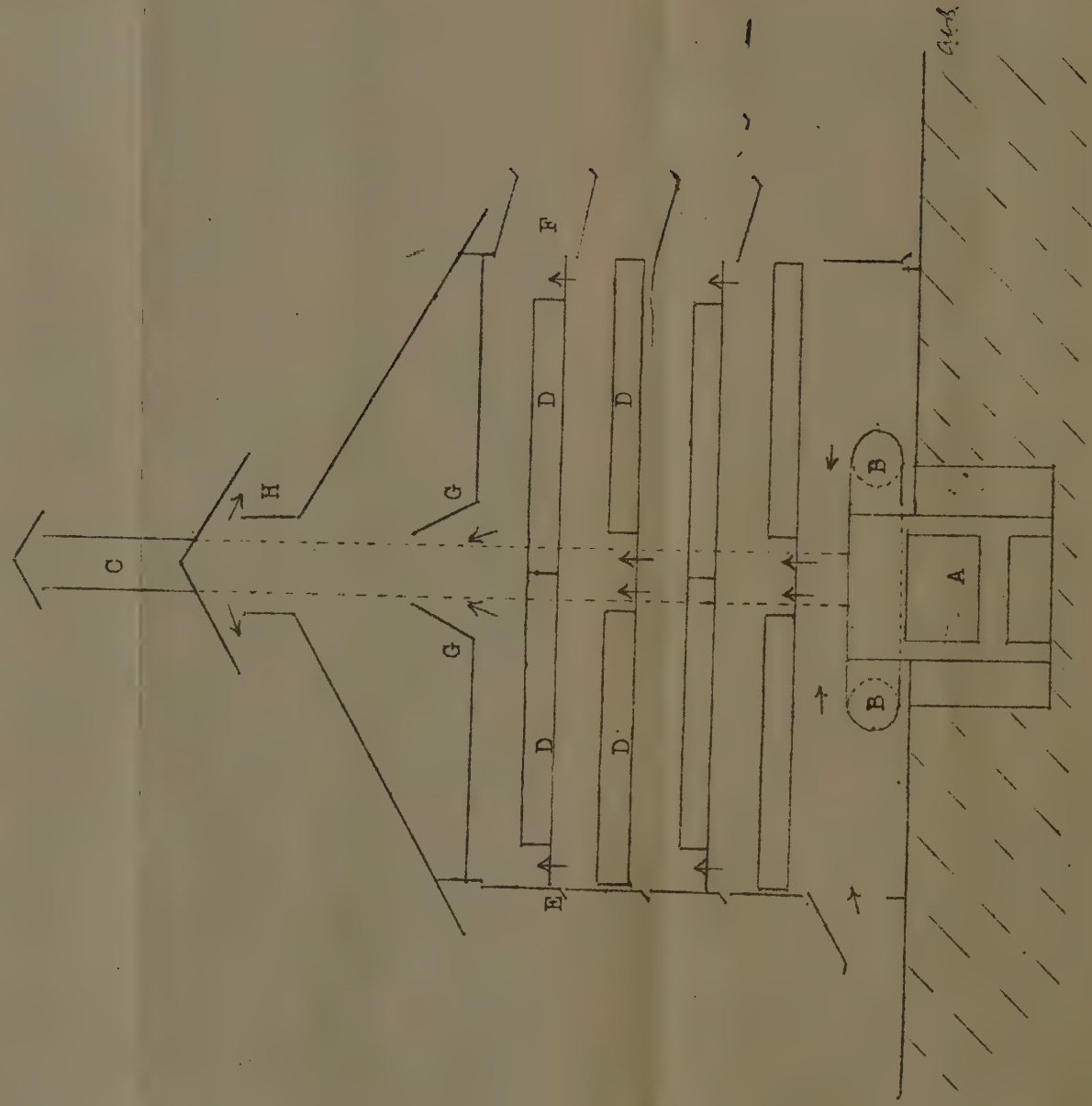
Sun drying.—The best method of drying the kernel and preventing more than the minimum decomposition of the oil is by exposure to bright sunlight in the open air, and it is in this manner that highest grade copra is produced. It is, however, by no means always possible to rely on weather conditions satisfactory for sun-drying, with the result that many methods of artificial drying, so designed in some cases as to facilitate the change over from sun-drying to artificial drying have been devised. Rainy weather is the bugbear of the copra maker. The large plantation owner overcomes the difficulty by using driers such as the "Chula," supplied complete by an English firm, or large locally-constructed driers of various designs.

Simple kilns.—The small producer also feels the need of some artificial drying kiln, and solves his problem by building a simple and usually ineffective erection which turns out a very inferior grade of copra. For example, in Zanzibar the kiln often takes the form of a shallow pit 8 or 10 feet wide, over which is erected a crude platform of branches and sticks. The kernels to be dried are piled on the top, and a fire started in the pit, the fuel being the husks of the coconuts. The product is black, insufficiently dried, and evil-smelling, and is quite unsuitable as a source of edible oil. It deteriorates seriously during storage and transport and commands but a low market price. An improved form of this type of kiln is in use, consisting of a low rectangular wall with a door at each end. The wall supports a framework of wood or iron rails which carries expanded metal or sticks and wire netting. This forms the platform on which the drying copra rests. The whole is covered by a thatched roof to keep out rain. Drying is effected by a small fire fed from each end of the large chamber under the platform, and hot air, mixed with the products of combustion, passes through the "kernels," which, though thoroughly dried, assume a dark-brown colour.

The objection to any kiln of this type is that the product is blackened by the smoke from the fire, and it is obvious that it is necessary to prevent access of the smoke to the drying material if the product is to be of good appearance. This can be effected with the kiln last described by making the platform of corrugated-iron sheets covered with clean sand, and by carrying off the smoke by a flue leading to a chimney near one end of the chamber. A simpler form of effective "sand-bath" drier consists of a channel excavated in the ground, with one end arranged as a fireplace and the other leading to a chimney, the channel being covered with sheets of corrugated-iron with sand on the top. The fireplace is closed in at the top by a layer of earth suitably supported, and the whole covered by a thatched roof. A number of such channels can be arranged radially around a central chimney. In situations where the nature of the soil is unsuitable for this underground-flue type, a similar effect can be achieved by building two, four, or eight chambers above ground, with flues leading to a common chimney, iron sheets covered with sand being used as before for the drying platform.

DIAGRAM SHOWING "RUNNING VATA" ADAPTED FOR HOT-AIR

DRYING OF COPRA.



A. Furnace.
B. Longitudinal flues.
C. Chimney.

D. Copra Trays.

E. Shutters as arranged for hot-air drying.
F. Shutters open for sliding out of trays, for sun-drying.

G. Baffle.
H. Ventilator.
Direction of hot-air currents.

The three kinds of "sand-bath" drier described are under observation on one of the Government plantations in Zanzibar Island. They will effectively dry coconut kernels in 36 to 48 hours, the copra being of excellent appearance and practically indistinguishable from the best local sun-dried product.

DETAILS OF "SAND-BATH" TYPE COPRA DRIERS.

		Area of drying Platform Sq. ft.	Capacity Kernels*	Cost of erection.
1. Large chamber type	.. ..	140	700	£15
2. Underground flue type	.. ..	138	700	8
3. Small chamber type	.. ..	135	700	8
		(2 platforms)		

* Kernels in shell. After a few hours drying the kernels are removed from the half-shells and dried on the same kiln. Kernels from 700 nuts make about 230 lb dry copra.

From the brief description and statement of costs of erection, it will be seen that these kilns are suited to the needs of the small producer. For this class of user, it is essential that the type of kiln adopted should be inexpensive and capable of construction from material available locally.

Design of driers.—In proportion to the amount of copra dried the quantity of fuel required is large. Such kilns or driers would not be suitable for the requirements of the large scale producer of copra. With larger installations it is essential to ensure that the design provides for the proper and effective circulation of warm air throughout the drying material. Of the two types, that is, the one in which the copra is placed in the drier in bulk and the other in which trays are used to carry the copra in comparatively shallow layers, the latter is preferable. In the former case although hot air can be drawn or forced through most of the copra it is inevitable that the air will pass through particular channels and that where the material is closely massed together a baking effect rather than an air drying effect will be exercised. With properly constructed tray driers continuous and regular circulation of warm air over the whole surface of drying material can be assured with the result that a uniform product is obtained.

In many districts in Fiji the usual type of "running vata" could be modified with advantage to provide for hot air drying during wet weather, and to speed up drying by working at night during busy periods. The normal construction would need to be altered somewhat, but the additional expense involved should not be great. The sides and ends would require to be fitted with shutters which could be opened and closed at will in such a manner as to permit of the movement of the trays. Heating would be provided by a furnace set low at one end having one or more wide section flues passing underneath the lowest range of trays, well clear of ground level, to a smoke box and chimney at the other end. Ventilators would be fitted in the roof and the trays so arranged that effective circulation of warm air over the copra was assured. When in use as an artificial drier the lowest shutters only would be opened. Natural draught would draw in cold air from outside which would be heated by the flues, and traversing the trays of copra, would pass out through the ventilators. The general scheme is illustrated by the diagram.

Economic factors.—There is no doubt that the quality of copra shipped from Fiji is capable of considerable improvement with a consequent enhancement of its market value. The main factor affecting the value of copra is its oil content. Next in order comes the free fatty acid content, which determines to a great extent the particular industry in which the oil will be

utilised. The most important aspect of copra preparation is the effective removal of water. This controls the ultimate oil content of the product and, to a very large extent, the quality of the oil obtained from it. The exclusion of foreign materials is also important.

The solution of the difficulties facing producers in Fiji is largely in their own hands, but merchants and Government must assist by ensuring that copra of good quality is purchased and shipped as such and not mixed indiscriminately with low grade material. Fiji can produce copra of good quality and if the best grades of copra realised their market value, undoubtedly would do so. The introduction of grading would be of great help to the producers as they would thereby receive a fair market price for their product. Reference to the reports by the Imperial Institute, London, (Appendix of this paper) shows that copra of good quality, dry, and of low free acid content is worth from 10s. to 15s. per ton more than the low grade material of approximately the same moisture content.

At present the copra market is depressed and producers are discouraged. The industry in this Colony is poorly organised. Production costs are high, transport is expensive, and the general standard of quality very low. The modern cry is for "rationalization" of industry. Our copra industry needs such organisation in the direction of increased production, lower costs of preparation, handling, transport and marketing, and improved quality of our product. By directing our energies along these lines we should be able greatly to improve the position of the copra producers of the Colony.

APPENDIX.

IMPERIAL INSTITUTE,
LONDON, S.W. 7

REPORT ON COPRA FROM ZANZIBAR.

The samples of copra which are the subject of this report were forwarded to the Imperial Institute by the Assistant Director of Agriculture and are referred to in his letter No. A.D. 1181/28 of the 5th November, 1928. The samples were stated to represent four grades of copra produced in Zanzibar, and it was desired to ascertain their quality and market value. Nos. 1, 2 and 3 had been produced on Government plantations whilst No. 4 had been purchased from a merchant and represented the normal product of the native and Indian copra producers.

DESCRIPTION.

No. 1 Sun Dried.—Weight, 5 cwt. 85 lb. Bold copra of fairly good appearance, in the form of large pieces, mostly half-nuts. The inner surface was mostly very pale and internally the copra was free from discolouration. Many of the pieces were covered with green mould.

No. 2 Kiln Dried.—"Artificially dried on a kiln constructed of corrugated iron covered with a layer of sand, with a fireplace and flue underneath." Weight, 6 cwt. Pieces of copra very similar in appearance to the above sample No. 1, but on the whole of rather better colour and less frequently covered with mould.

No. 3 Smoke Dried.—"Prepared by drying on a platform constructed of iron rails and expanded metal over a large chamber with a fire door at each end. Coconut husks were burnt in the chamber and the products of combustion passed through the drying kernels." Weight, 5 cwt. 53 lb. Large pieces of copra (mostly half-nuts) of fair appearance, but in many cases covered with mould. The inner surface varied in colour from very pale brown to reddish-brown. Internally the copra was mostly free from discolouration. The sample had been slightly attacked by insects.

No. 4 Fair Average Zanzibar Quality.—Weight, 6 cwt. 27 lb. This sample consisted partly of half-nuts, but mostly of small pieces and dust. The copra was dirty and of very poor appearance, and was slightly attacked by insects. The inner surface of the pieces varied from brown to very dark brown, being chiefly dark brown, and was also mouldy. Internally most of the pieces showed discolouration for part of the thickness.

Results of Examination.—The samples were examined with the following results:—

	No. 1. Sun-dried.	No. 2. Kiln-dried.	No. 3. Smoke-dried.	No. 4. Fair average Zanzibar quality.
Moisture per cent	4.1	4.1	3.8	3.3
Oil in copra as received per cent	67.4	65.7	67.8	69.6
Oil in moisture free copra per cent	70.3	68.5	70.5	72.0
Acid value of extracted oil .	0.7	1.0	0.8	24.6
Free fatty acids (as lauric acid) in extracted oil, per cent	0.25	0.36	0.29	8.78

The oils as extracted from the copras with light petroleum were in general of normal appearance, but those from samples Nos. 3 and 4 had a yellowish tint.

The foregoing results show that the four samples all contained normal amounts of moisture, whilst the yields of oil compare favourably with the figure of 66 per cent. regarded as the minimum desirable for copra of good merchantable quality. Sample No. 4 (Fair Average Quality) contained the largest percentage of oil and No. 2 (Kiln-dried) the least.

The acidity of the extracted oils was very satisfactory in all cases with the exception of sample No. 4, the oil from which contained a high percentage of free fatty acids.

The three experimental samples, Nos. 1, 2 and 3 were all much better than the commercial sample No. 4 as regards both appearance and the acidity of the extracted oil. There was not much difference between the sun-dried sample No. 1 in appearance, but the former contained rather more oil which was of slightly better colour.

Commercial Value.—The samples were submitted to a firm of copra brokers in London, who furnished the following report:—

No. 1.—An exceptionally good delivery of F.M.S. Zanzibar, containing a few pieces slightly affected by mould and having the appearance of having been slightly overdried.

No. 2.—A very good delivery of Zanzibar copra, being clear and white in appearance. Would compare very favourably with Sample No. 1, with the difference that it seems to be hot air dried.

No. 3.—A good delivery of selected smoke-dried Zanzibar copra of particularly white and clean appearance.

No. 4.—A poor delivery of F.M. Zanzibar, of dirty appearance, and containing too much dust and small pieces.

The firm also made the following observations on the value of the samples and the market for Zanzibar copra:—

The appearance of samples Nos. 1 and 2 was very similar, except that No. 2 was a little whiter than No. 1. Both these samples were extremely good copra and very much superior to what is generally expected of Fair Merchantable Sun-dried Zanzibar. No. 3 was a very good smoke-dried copra and much superior to what is generally expected of this grade. Sample No. 4 had the appearance of ordinary Fair Merchantable Zanzibar which we are accustomed to seeing, except that it was of rather inferior quality, and a small allowance would have been given on same if arbitration had been claimed.

We notice that samples Nos. 1, 2 and 3 were produced on Government plantations, and no doubt this accounts for the greatly improved appearance and quality. We are perfectly sure that if the cost of producing copra up to this standard is not a great deal more, the producer would obtain a better price if the buyers were sure that they were going to get a good grade of copra, as per these samples. Zanzibar copra has always been known by the high contents of oil, but it has always been a very irregular description as compared with other qualities, owing to the variable weather, and very often Zanzibar copra, when it has been left out to dry, has got damp and this has caused it to become decomposed and dark in colour, this affecting the quality of the oil.

During the last year or so the best market for Zanzibar copra has been Genoa, where one or two crushers have been prepared to pay considerably better prices than anywhere else. These Italian buyers have used it, as far as we are aware, chiefly for soap-making, and therefore we rather doubt whether they would pay an extra premium for obtaining a higher grade quality, but to other ports, such as Marseilles, London, Rotterdam or Hamburg, where this copra is occasionally sold, the buyers would probably pay for samples Nos. 1 and 2 fully 10s. to 15s. per ton more than is usually obtained for ordinary Fair Merchantable Sun-dried Zanzibar, and 5s. to 10s. per ton more for sample No. 3 than is usually paid for Fair Merchantable Zanzibar; but it would be necessary first to let the various buyers (of whom there are a fair number) have samples of these grades, and also they might wish us to give some guarantee that any shipments made would be up to the standard of these samples.

The nominal value to-day of Fair Merchantable Sun-dried Zanzibar for April-May shipment to London, Rotterdam, Hamburg or Marseilles is about £22 15s. and that of Fair Merchantable Zanzibar £22 5s. per ton, but the Italian buyers would probably pay about 10s. per ton more to Genoa. We repeat ourselves in saying that to the first named ports we could probably obtain 10s. to 15s. above these figures for the present samples.

The market for copra has steadily declined during the past year, owing to the heavy shipments of copra generally from all producing countries, and at the present time is in a very dull state.

Remarks.—The results of this investigation show that the quality of Zanzibar copra could be considerably improved by more careful drying either in the sun or in kilns. The smoke-dried sample No. 3, although superior to the commercial product represented by No. 4, was inferior to the sun-dried and kiln-dried samples Nos. 1 and 2.

In the opinion of the brokers, copra similar to samples Nos. 1 and 2 would probably realise 10s. to 15s. per ton more than the ordinary fair average quality and No. 3, 5s. to 10s. per ton more. If these increased values are sufficient to render preparation by the improved methods remunerative, it would be advisable, when commercial quantities are available, to adopt the brokers' suggestion and forward large samples to the Imperial Institute for distribution to possible purchasers.

28th March, 1929.

His Excellency the Governor.—Mr. Kermack is unfortunately ill and unable to attend the conference. I will ask Mr. Barnes to read the paper on *Banana Cultivation in Fiji*.

FRUIT PRODUCTION FOR EXPORT—PART II,—CULTIVATION OF THE BANANA IN FIJI.

By JAMES KERMACK, Assistant Superintendent of Agriculture and Inspector of Produce.

Introduction.—The main object of this paper is to offer for consideration a few simple yet effective methods of cultivation which might readily be adopted in Fiji, where banana growing is now entirely in the hands of natives, whose system of planting and cultivating is generally speaking, primitive and crude in the extreme. Before, however, any suggestions are made, it might be well that a brief history be given of the industry in the Colony since 1914, when production of fruit reached its peak with shipments during that year, amounting to 1,715,766 bunches, equivalent to approximately 858,000 cases.

History of industry.—On the island of Vitilevu in districts where transportation is convenient and where probably soil and climatic conditions are more favourable to the production of first-class fruit than elsewhere in the Group, the banana industry in 1914 assumed considerable proportions and was more or less controlled by Europeans who by systematic cultivation, produced sufficient fruit of exceptionally fine quality to supply the demands of the Sydney, Australia, and Auckland, New Zealand, markets. A decrease of 700,000 bunches in 1915 due to a severe windstorm and floods in the latter part of 1914 apparently had not a depressing effect on the industry, as in the following year, production increased to within 65,000 of the record shipment of 1914. Unfortunately, the reactionary period was short lived and in 1917 effects of the introduction into or the development in the Colony of a fungus disease *Cercospora* locally termed "Sigatoka" the name of the district where it was first detected in Fiji, which attacked the leaves and in a short space of time defoliated the tree, were only too obvious through a considerable decrease in production of fruit during that year. Operating concurrently with the leaf spot *Cercospora* disease were "Bunchy top" (*Pentolonia negronervosa*), a virus transmitted by a small insect the banana aphid, the banana weevil borer (*Cosmopolites sordidus*),

the most serious insect pest affecting the banana plant in Fiji and "Banana Scab," the result of a deposit of larvae of a small moth which disfigures the skin of the fruit in its early stage, and experiments were immediately made by the Department of Agriculture in an attempt to control these different diseases and pest troubles by spraying and the introduction of parasites, but little or no success was met with. It is therefore not surprising that production of fruit in 1919 should drop to 614,722 bunches which is the normal requirement of the Auckland, New Zealand, market. In 1921, what amounted to an embargo on Fiji bananas through the imposition of a duty of one penny per lb by the Australian Commonwealth Government, shipments to that country were, with the exception of small consignments from time to time, discontinued, shippers considering that the high tariff precluded the possibility of a profitable market. New Zealand, the only other nearby available market, still offered possibilities but the limited quantity of fruit which a comparatively small population could absorb was evidently not sufficient for Europeans continuing operations and gradually their cultivations through neglect, possibly due to the high cost of necessary labour, were abandoned, leaving natives who had all along been associated with the industry, in the growing of small patches of bananas in conjunction with yams, dalo, &c., in their village provision grounds, sole producers. Banana growing with the average native, however, had been and to a great extent still remains a secondary consideration to the production of his staple food, yams and dalo, and whilst he probably realises vaguely that it means for him a source of revenue each month throughout the year, he does not look upon it from a commercial viewpoint, neglecting as he does the irregularly planted patches as soon as his provision crop is harvested. A steady decline in fruit production since 1921 was viewed with considerable alarm in 1927, and with the object of placing the industry on a better footing and to ensure a regular monthly shipment of from 20,000 to 25,000 cases to Auckland, a cleaning up of native plantations campaign was instituted by the Agricultural Department, the work, under the supervision of European Field Inspectors, who were appointed by the Government under the Diseases of Plants Ordinance, to be undertaken by natives at such times throughout the year as would not conflict with their communal operations. A degree of success was claimed in the initial stages, but it was latterly found that many, if not most of the fields were so badly infected with leaf spot disease and infected with the banana borer weevil that in order to save the industry a general planting up by natives of new areas was necessary. Additional Inspectors were appointed in 1928 and with the object of developing areas sufficiently large to ensure at least an export of the quantity of fruit already stated operations in the latter part of that year were commenced in the Wainimala, Wainibuka and Waidina districts on the island of Vitilevu, where it was considered stretches of rich alluvial river flats, isolated from old cultivations still existed. To date slight progress only has been made, approximately 330 acres having been planted with suckers which were carefully selected and examined by Inspectors for borer infection and whilst it is gratifying to know that the new fields which are gradually coming into bearing are yielding sound, marketable fruit, it is now realised from the fact fruit production during 1929 reached a low level of 185,000 cases or 370,000 bunches and falling short by some 80,000 cases of the minimum requirement of the Auckland market, that if a more active course of planting, systematic cleaning and pruning and draining of the land where necessary, is not adopted there is a grave danger that a valuable though comparatively small industry will be lost to the Colony.

SUGGESTIONS FOR IMPROVED METHODS OF CULTIVATION AND
HARVESTING AND TRANSPORTING OF FRUIT FOR EXPORT.

Selection of Land.—Selection of land which is near to convenient water or roadway transportation should be a first consideration of the prospective planter provided the soil is suitable. The nature of the soil can be more or less determined by its general appearance and as most agriculturists are or should be able to discriminate between poor and rich soils there is small necessity for a chemical analysis being made. The banana will grow on a great variety of soils, but apart from the rich alluvial river flats where the soil is ideal perhaps the best soil for its culture is a deep loam composed principally of sand and clay, and containing a good proportion of lime and humus. Humus, otherwise decayed vegetable matter, is highly essential to all plant life, probably more especially to the banana, through its supply of nitrogen. Care should be taken that the area selected for planting is well protected from high winds which tear and wither the leaves, thereby retarding the growth of the plant and for this reason steep hillsides on the weather side should, if possible, be avoided.

Preparation of Land.—Land should be prepared during the dry season and immediately prior to spring, which is the planting season. Clearing operations are comparatively easy during that period, but the tendency for convenience to burn the cut grass and bush should, unless it is extremely light, be discouraged, as by heavy firing a considerable portion of plant food may be lost through the destruction of the surface humus in the soil. Where practicable all grass should be dug into the soil, otherwise it should, along with the cleared bush, be removed to a place outside the area to be planted, and burned. Alignment of the field should be undertaken immediately clearing operations are completed, spacing the distances where the plants are to be placed not less than 12 feet apart, but preferably 15 feet, which allows for proper ventilation or air current, convenient cultivation of the land and ample room for the development of the banana roots which require a radius of from six to eight feet. Holes should then be dug where the suckers are to be planted, the depth of the hole varying with the conditions of the soil. In heavy soils a depth of $2\frac{1}{2}$ feet with a corresponding width should be considered, filling in with loose surface soil. This will permit of the roots getting a good start without having to unduly force their way, and the plant becoming thoroughly established in its bed in a comparatively short time. In free soil a shallower depth of, say, $1\frac{1}{2}$ to 2 feet would be sufficient.

Drainage.—Whilst an abundant rainfall is necessary to the satisfactory growth of the banana, good drainage is highly essential and it should be one of the first considerations of the planter to see that where there is a surplus of water in the soil, a system of drains is undertaken prior to the planting of his field. By doing so danger of the soil becoming waterlogged and air passages thereby blocked will be prevented. Where soil is light and porous drainage should be limited, as there is always a danger of making the soil too dry by overdraining. It must always be borne in mind that the principal object of drainage is to prevent stagnation of water in the soil. The method of drainage usually adopted in banana fields is by trenching to a depth of from three to four feet at distances varying from 30 to 60 feet apart, according to the nature of the soil. Sump drainage however, where the subsoil is of a porous character, could be economically undertaken and be quite effective by digging holes say four feet in width to a depth that would reach the porous strata in different places throughout the area. The sump system where practicable commends itself as no

subsequent attention is necessary, as would be the case with trenches, which require periodical clearing of fallen banana trees, leaves and other vegetable matter.

Planting.—Spring is the natural time of the year for planting, although operations may be continued during the early part of summer with a degree of success provided there is sufficient, but not excessive, rainfall. Every attention should be given to the selection of suckers which should be taken from plants which show vigorous and healthy growth. Great care should also be exercised when removing suckers, which should have about six months' growth, from parent plants. In the absence of the proper type of tool for this purpose, a cane knife is invariably used, but such method is inadvisable, as there is always a danger of injury being done to other suckers by what is termed "bleeding" or wounding by cutting which would retard growth and probably affect fruiting. The proper tool to use is a narrow semi-circular spade with which it is possible to sever the sucker with little or no risk of damage in the operation. After a sucker has been removed the roots should be trimmed, as also eyes cut off with the exception of one which would appear to be the strongest. It should then be cut to within six inches of the bulb and planted with the eye five or six inches below the surface.

Cultivation after Planting.—Fields should be kept entirely free of weeds and on this account considerable labour is usually expended by the planter in cleaning, either by hoe or plough. A method, however, which not only obviates to a great extent the necessity of weeding but also is a means of conserving moisture in the soil is mulching. Dry grass is effectively used in different countries where the soil is dry and rainfall low, but this form of mulching does not altogether commend itself where insect pests abound, as decaying vegetable matter spread over the surface of the soil might harbour them. The planter should have in mind the danger of the banana borer weevil in this connection. A system of green mulching or green manuring is generally accepted as a most economic means of controlling weeds and at the same time enriching the soil. Mauritius or any other beans might be planted immediately the land is cleared and would effectively act as a cover crop until cut down after seeding, when they should be forked or ploughed into the soil close to the plant during the dry season, when the soil is in a condition to be worked. By continuous and systematic cultivation, bananas in suitable soil should give good returns for a number of years. A field with plants, say, 15 feet apart or approximately 200 to the acre when properly cultivated should yield anywhere from 250 to 300 bunches per acre, 75 per cent. of which should be nine hands or over.

Pruning of Plants.—Pruning is one of the most important operations in banana culture and should be undertaken when the plant is young. Too many suckers attached to the root must necessarily rob the parent of a certain amount of food and for this reason it is desirable that a limited number should be allowed to grow and in time produce fruit. It will therefore be understood that the object of pruning is to conserve the vigour of the plant which is to produce the first fruit and at the same time assist the growth of its followers, which will eventually take the place of the former after the fruit has been reaped. Not more than three suckers, although two is more advisable, should be left to follow the fruiting plant, if possible at equal distances around the bulb. The suckers left as followers should be at different stages of development in order that no two plants will be fruiting at the same time. By this system consecutive bunches of first-class fruit may reasonably be anticipated. The method of detaching suckers

from the parent plant has already been dealt with in this paper, but it may be well to again recommend care in the operation. When digging out suckers it is important that they should be severed completely from the bulb or corm as otherwise they will spring again in a quick space of time which would necessitate the pruning operation being repeated.

Diseases and Pests.—No effective means have yet been discovered whereby the different pests and diseases of bananas in Fiji can be controlled, but it is considered they may be minimised by keeping fields free of all fallen leaves, cut banana stems and any other decaying vegetable matter which might act as harbours. In the case of the scab moth a certain degree of success has been obtained in combating this trouble by dusting the flower of the banana immediately it shoots with Pyrethrum powder and planters should realise that by daily attention to the plants this method of treatment will save at least 75 per cent. of the fruit produced. Another pest, the banana borer, may be trapped in large quantities by cutting up pieces of banana stems and placing them at different intervals around and near to the plant. A tour of inspection should be made every morning to collect the beetles which invariably will be found under the freshly cut stem which is particularly attractive to them.

Harvesting and Marketing of Fruit.—Under favourable conditions the banana fruits in 10 to 12 months from the time of planting. A period of from three to four months is required for the development of the fruit to a stage at which it may be harvested. The proper grade or size of fruit to harvest would all depend on the distance the place of production is from a market and over what period transportation would extend. Assuming that the period is ten days and that six days of that period is utilized in handling and transporting the fruit to a steamer, fruit three-quarters developed should be considered as it not only carries well but is of commercial size and marketable the year round. Fruit matures more rapidly in the moist warm months than during a dry cool spell and if shipments are not frequent, say, once every two weeks there may be considerable loss in the field through fruit becoming overfull, due to a sudden change in weather conditions from cool to warm. In order, therefore, that there be no undue loss through marketable fruit being left on the plants when there is an opportunity to ship, it is highly essential that sound judgment be used in selecting the fruit to cut. Fruit should be cut either the day it is to be packed or not earlier than the previous day. In the operation care should be taken not to bruise the fruit by careless and rough handling which may not show at the time but eventually would when it commences to ripen by going black. Careful handling makes all the difference to satisfactory carriage and subsequent sale of fruit. After being cut it should not be exposed to the direct rays of the sun, otherwise it will scorch or be affected in such a way that it will in a short time become soft and be unfit for the market. An open shed is an ideal shelter prior to packing, but this is not always practicable and dry banana leaves make an excellent substitute. Packing should be undertaken with the same amount of care as would be exercised in harvesting. Placing of fingers in the case which should be absolutely dry and clean is a highly important operation and this should receive the greatest attention. A loosely packed case is as hurtful to the fruit as one packed too tight. If the former method is adopted there is danger of skin disfigurement by rubbing of the fingers through transport vibration whilst the latter through undue pressure is likely to cause bruising. Transport from the field by punt, cutter or lorry of the cases containing fruit to the port of shipment should be done as expeditiously as possible,

but care must be taken that the cargo is not allowed to shift and be knocked about. When by punt or cutter which usually involves a long and sometimes tedious journey, good ventilation is necessary and to avoid cooking or excessive heating of the fruit sufficient air space by dunnaging between the rows of cases should be allowed. Protection against sun and rain must also be considered and an awning should always be in readiness should such be required. Loading on to the steamer is undertaken by the shipping company, and shippers should make it a point to see that the fruit is not roughly handled on the wharf and that it is conveyed to the vessel's hold in a careful manner.

Mr. MacDonald.—From my observations I conclude that the beetle introduced by Mr. Jepson is effectively controlling the weevil borer in some districts.

Mr. Faddy.—Some years ago we could not get a stand and I have planted a field five times. That was before the Jepson beetle arrived. Then we planted an area with 500 bananas and there was no trouble to get 100 per cent. established.

Conference adjourned at 3.50 p.m. until 10 a.m. on the 18th January, 1930.

Conference resumed at 10 a.m. on Saturday, 18th January, 1930.

His Excellency the Governor.—*The first paper to be read this morning is by Mr. Surridge, on the subject of Green Manuring.*

GREEN MANURING.

BY H. R. SURRIDGE, A.R.C.Sc., (I), Agronomist, Coconut Committee.

Introductory.—The object of this paper is to attract and stimulate interest amongst the various planters in these islands, in the very sound and inexpensive agricultural practice of green manuring. For this purpose the subject has been treated simply, so that planters who are interested and wish to know more of the matter may obtain further knowledge and help, first on application to their Department of Agriculture in Suva, and where interest is exceptionally keen, by a study of various books, *e.g.*, Halls *Fertilisers and Manures*, de Sornay's *Green Manures and Manuring in the Tropics*, *The Tropical Agriculturist* Vol. LXXIII No. 3, Sept., 1929, and others. That the practice advocated in this paper is essential is demonstrated by the world-wide scarcity of farm yard manure and the need for satisfying the soil's demand for humus, and by the necessity for the application of more intensive methods of agriculture, particularly in those countries where land is restricted in quantity owing either to density of population or difficulties of transport.

Historical.—In the history of agricultural practice, green manuring has long held a prominent place, something of its value having been known to the Romans 2,000 years ago, and to the Chinese over 3,000 years ago, but it is only in recent years that a truer appreciation of its uses and value have come to be known. The Romans noted that when corn succeeded their bean crop a much better yield resulted. The result of this observation was the regular inclusion of beans in their system of crop rotation. This practice became common throughout the greater part of Central Europe and eventually extended to England, but its value was not appreciated there until the 17th–18th Centuries. Agriculture in England up to the

early part of the 17th Century had made very little progress, but with the increasing importance of the wool industry, the changing dietary from fish to meat, of an increasing population, and the introduction from Europe of new types of farm crops, a more intensive system of agriculture was evolved, involving the more active use of green manures.

Up to about 1700 the usual crop rotation was wheat, oats or barley and fallow, but Lord Townsend about this time endeavoured to grow, on his farm in Norfolk, turnips introduced from Belgium and Holland, and, after considerable difficulty, succeeded about 1725 in growing this root crop, thus adding one more crop to the farmer's rotation. But the fallow was still included in that rotation until experimentation demonstrated that with the introduction of another green manure crop (red clover in this case) not only could the new root crop be successfully grown, but owing to the soil rejuvenating qualities of the clover and bean crops, it was possible to dispense entirely with the fallow. This proved a most important innovation for the farmer because, first, it rendered all his land productive all the time, and second, that through this intensive cultivation he was able the more effectively to carry his live stock on through the winter with the additional feed obtained and thus cater for the increasing demand for meat and farm products. It was not until the 19th Century that investigation revealed how bean, clover or pea crops benefited the soil. Experiments carried out at Rothamsted about the middle of the 19th Century demonstrated that the nitrogen content of a soil was increased after a crop of bean or peas, irrespective of whether the bean or pea crop was harvested or not, it being the general custom to harvest the haulm and plough in the stubble. Subsequent experiments proved that if the haulm also was ploughed in, there was a still further increase in the nitrogen content of the soil. It was further found that this property was peculiar to plants belonging to the botanical order of the Leguminosae, with the result that since nitrogen is the most essential ingredient of plant food, as well as the most expensive of fertilisers to purchase, plants of this order have obtained precedence over other plants as green manuring crops.

Definition and uses.—Green manuring is the process of ploughing in various types of farm crops for the purpose of maintaining and increasing soil fertility. When considering green manuring three other important uses may be mentioned—

- (1) as cover crops, to keep down weeding;
- (2) for soil protection against erosion, particularly on undulating land and hill sides;
- (3) as insect pest controls.

Humus.—Other possible uses will occur to the practical farmer to his ultimate benefit. Dealing first with the main purpose of increasing soil fertility, it is of interest to know something of how this is accomplished. One of the most important constituents of a fertile soil is humus. A lack of humus is invariably the sign of a poor soil. Humus is decaying organic and vegetable matter, and functions chiefly by—

- (1) maintaining and increasing soil moisture;
- (2) forming, in its decomposition, humic acid, which interacts with various soil materials, thereby releasing plant foodstuffs;
- (3) supplying foodstuffs for various beneficial soil organisms, which in turn, assist in increasing the supply of plant foods in the soil;
- (4) assisting in aerating the soil.

Leguminous Plants.—In closely-settled countries, up to recent times, farmyard manure was the main source of supply of humus, but with the

advent of the motor, this, the best of all manures, is not obtainable in sufficient quantity; especially is this so in the tropics, with the result that other sources of humus have had to be explored. The continual application of mineral manures without a sufficiency of humus, impoverishes the soil, so that circumstances have compelled the farmer to consider green manuring for its humus, as well as other elements of plant food that are required. In leguminous plants he found a substitute giving him a good supply of humus, and an appreciable amount of that most expensive and necessary of plant foods, nitrogen. An examination of the roots of these plants shows that they have a large number of nodules adhering. These nodules are colonies of bacteria which have the power of assimilating atmospheric nitrogen, and passing it on to the plant in a form which the plant can use for its own growth, and it is the result of this working together between the legume and the bacteria that ultimately results in an increased amount of nitrogen in the soil, whether the crop is ploughed in or not, in a form readily available to the succeeding crop. Experiment has demonstrated that more benefit results to the soil and the standing or succeeding crop when the leguminous crop is ploughed in just about flowering time, rather than running it on to seed.

Use as Green Manures.—Here in Fiji we have continually before us the advantage of green manuring on systematic lines, in the sugar-cane areas of the Colonial Sugar Refining Company Limited. This Company, by the application of green manuring, have not only maintained the fertility of their estates over a great number of years, but have in most instances increased that fertility, and, in other cases, turned and are turning the arid red lands, met with in some parts of these islands, into cane-growing areas through the systematic use of leguminous crops for green manuring. With such a practical demonstration of the benefit of green manuring before one, one wonders why the practice is not more general amongst the planters of these islands.

Coconut Plantations.—The copra industry, at present, is depressed, and there does not appear to be much hope for any marked increase in the market price of this commodity for some time to come, with the result that the producer must consider ways and means of reducing his costs and increasing his production per acre to counteract the loss of income produced by low prices. One method of assisting in attaining this desirable object, is to practice the art of green manuring on the plantations. It is reasonable to assume that the coconut will respond, as other farm crops do, to better feeding and cultivation, within limits. Being slow in its growth, in coming into bearing, and in maturing its foliage and fruit, suggests that a steady supply of plant food is essential for the proper development of the tree and its fruit. For this reason, the application of quick acting manures like nitrate of soda or sulphate of ammonia cannot be recommended, apart from their expense, rather the slow acting and cheap green manure, as supplied by a leguminous crop, seems to answer the necessary requirements. Compared with the artificial fertilisers just mentioned, green manures are slow in their action, and in their decomposition maintain a steady supply of the essential plant foods, nitrogen, of course, being the most important. Add to this the very efficient control such crops have over weeds, the additional humus when ploughed in, thus increasing the moisture content of the soil, particularly during dry spells—an important factor in maintaining an adequate food supply for the tree—and the result should be a reduction in weeding costs on the estate, a cheaper manure bill, the maintenance and probable enhancement of the soil fertility, and an improvement in the general health of the trees so that the yield should be increased.

Coconut Estate Practice.—Present day practice on coconut estates in these islands consists roughly of three kinds—

- (1) neglect (mainly native plantations);
- (2) weeded, either by hand or plough;
- (3) the running of cattle under the trees in other words, these plantations are nominally under grass.

In the case of No. (1) this matter is being dealt with by the Coconut Inspectors who are instructing and encouraging the native to tend his copra plantation with method and intelligence.

Under No. (2) this practice has little to commend it. The ploughing in of weeds gives little, if anything, more than humus and it is extremely doubtful whether this practice pays for the labour involved.

With reference to No. (3) effective weed control is seldom established by cattle, as shown by the presence of lantana, "Koster's Curse," guava, &c., in many plantations running cattle amongst the trees, and it has yet to be proved that coconuts thrive to the best advantage when the ground is covered with grass.

In fruit orchards it is an established fact that in the presence of grass the trees are not so vigorous, the fruit smaller in size and of poorer quality though richer in colour than similar trees in a cultivated orchard. The two chief reasons for this are thought to be (1) presence of excess of carbonic acid gas in the soil, and (2) nitrogen starvation.

Dealing with (1), grass usually forms a dense covering of matted roots which prevent free circulation of air and water. These roots are continually exuding carbonic acid gas, a gas which, being heavier than air, gradually percolates down to the roots of the trees, inhibiting them in their function.

In the case of (2), it is known that the nitrates in the soil occur within the top few inches, so that as this is produced either by rain or bacteria so the grass secures first claim on this important plant food, to the loss of the trees under which it is growing, hence a type of nitrogen starvation for the tree occurs. Such conditions apply to fruit plantations and it is to be expected that similar conditions operate in coconut plantations.

Effect of Leguminous Plants on Soil.—The effect of growing a leguminous crop is opposite to that of grass. Legumes ameliorate the soil by their root action, aerating it, making it much freer for working, and as already mentioned, increase the nitrogen content of the soil, so that the coconut tree stands to receive not only those nitrates naturally formed in the soil, or obtained from the air through the rain, but also those obtained and stored in the soil by the use of the leguminous crop. The result then should be to the advantage of the coconut, a result which planters in the Dutch East Indies, the Philippines and Malaya experience.

Soils.—As regards soils suitable for these green manuring crops, it may be generally stated that all coconut soils will produce leguminous crops. Undrained land does not favour the legume, neither does it favour coconuts, and sour land refuses to grow such crops until the acidity is corrected, the acidity restricting and destroying the activity of the essential bacteria, but application of lime, whether as lime or coral sand, or coral, will rectify this and enable such land to produce good leguminous crops. In these islands coral sand is generally obtainable at little expense.

Time for Ploughing in of Green Crops.—The time for cutting a green manure requires consideration. It is essential that the ground should be covered, particularly during the dry spell, so that if the legume is sown just before the wet season, it should, if an annual, mature towards the end of that season, allowing for some seed to be harvested, and some to be

ploughed in with the haulm to secure a volunteer crop to cover the ground during the dry spell. At the same time, it must be remembered that the maximum nitrogen content in such a crop occurs, as already mentioned, just about flowering time, so that local conditions of seed, manure and other requirements will control when the crop should be ploughed in.

Type of Legume Suitable.—The type of legume here considered is the herbaceous annual, e.g., mauritius bean (*Stizilobium atterimum*), rice bean (*Phaseolus calcaratus*) or cowpea (*Vigna*), these being the green manuring crops with which planters in Fiji are most familiar, particularly in and near the sugar-producing areas. The advantages of this type of legume are: (a) its manipulation requires the minimum of man power; (b) it covers the ground and controls the weeds rapidly; (c) it furnished supplies of food for man and beast if required; and (d) it produces on the average about five tons of green manure per acre with a fair supply of nitrogen. Where circumstances permit, an application of either coral sand or a combination of a phosphatic and potassic fertiliser would considerably enhance the value of the green manure.

Clover Sickness.—The bush type of legume, however, does not appear to be suitable for our local conditions; first, because hand labour is required to undertake the periodical prunings or loppings of these bushes, and second, because of the difficulty involved when it becomes necessary to eventually plough in this crop, since the stools of these bushes become very woody towards the end of their first season's growth. Such crops, being perennial in habit, would occupy the ground continuously for several years and by so doing, bring about that soil condition popularly known as "clover sickness." In the case of the herbaceous legume such a condition need not arise if two annual legumes are used on the plantation, for the changing of such legumes periodically, each occupying the other's ground, after say two or three volunteer crops have been ploughed in, would tend to prevent "clover sickness."

Varieties of Legumes Suitable.—I am indebted to the *Tropical Agriculturist*, Vol. LXXIII, No. 3, Sept., 1929, for a summary of those legumes in use in Ceylon, Malaya, the Philippines and Dutch East Indies, and below I give extracts of descriptions of those legumes which appear to be suitable for the conditions obtaining here in Fiji.

1. Peanut or Groundnut (*Arachis hypogæa*). Very useful as a green manure owing to its rapid growth. Suitable in dry districts. Good fodder. Not recommended as a catch crop owing to its attraction for rats.
2. Cowpeas (*Vigna catianga* or *V. sinensis*). Suitable for young and old plantations. Is a quick growing annual, forms excellent cover in 3-5 months, thrives on poor land and withstands drought and shade.
3. Mauritius bean (*Stizilobium atterimum*, *mucuna spp.*) Suitable for young and mature plantations and light shade. Is quick growing and when mixed with cowpea in proportion of 1 of cowpea to 4 of mauritius bean, a very quick and efficient ground cover is obtained.
4. Rice bean (*Phaseolus calcaratus*). An excellent bean, withstanding shade. Slow in getting away, but mixed with some cowpea the ground is quickly covered.

It would be necessary to experiment with the others mentioned in the list but not quoted here to observe their behaviour and suitability under the conditions prevailing in Fiji. Of those quoted, three as previously men-

tioned, are already in use on sugar estates and seed can, no doubt, be obtained by those planters who wish to do so, without difficulty.

To summarise, green manuring is an old established agricultural practice which has been proved to be of great value to many crops in many countries under varying conditions. For the coconut planter it offers a means whereby copra production can be increased at a very small expense, an expense which is offset by the saving of labour required for weeding. It furnishes a steady supply of humus, and an appreciable amount of nitrogenous plant food, thereby increasing the water-holding capacity of the soil and supplying a fair proportion of the most expensive of essential plant foods, nitrogen. Its practice has been shown to benefit plantations in Ceylon, the Philippines, Malaya and Dutch East Indies, and it is reasonable to expect that a like result will accrue here in Fiji if planters will adopt the use of legumes as green manuring crops.

Finally, while this paper has dealt more particularly with green manuring as applied to the coconut plantations, a similar result would be obtained if the practice was extended to other tropical crops, whether annual or perennial in character, *e.g.*, bananas, pawpaw, potatoes, &c.

His Excellency the Governor.—I congratulate Mr. Surridge on his paper. I have listened with the greatest interest to it. Green manuring is a subject with which I have had limited experience. Mr. Stockdale, who is now Agricultural Adviser at the Colonial Office, preached the doctrine of green manuring in Ceylon. It is a matter which has been closely gone into by the farmers in Ceylon particularly on tea, rubber and coconut plantations. Mr. Surridge has not dealt in detail with the valuable use of cover crops to prevent soil erosion. In Ceylon, where the hills run to 7,000 feet high, tea is planted on steep slopes and the humus is being washed down into the rivers and low country. I think this is a problem we will have to study in Fiji. My knowledge of the country is not very extensive at the present time, but we have heavy tropical rain and unless steps are taken by way of cover crops and terracing to prevent the soil getting washed away we shall find ourselves in a very precarious position.

Mr. Duncan.—I am doubtful as to the advisability of planting leguminous crops indiscriminately among the coconuts. In my experience it is preferable to run stock in the plantations, by which means the ground can be kept satisfactorily clean. A dense mass of vegetation, even if it were leguminous, would make it difficult to collect nuts and would preclude the grazing of cattle amongst the trees.

Mr. Surridge.—The main object of my paper is green manuring. The question as to whether any particular legume is beneficial for stock food would have to be gone into. There are two considerations, namely, the effect of the legume on the quality of the milk and also on the quality of the meat.

His Excellency the Governor.—With regard to cattle running on a coconut plantation, I know one of the largest planters in Ceylon whose plantation is one of the best I have seen. He is very particular about keeping down the noxious weeds and his cattle are a very valuable asset to him. I do not know whether it is the practice in Fiji to run cattle on coconut plantations.

Mr. Surridge.—With regard to the running of cattle on coconut plantations, I do not think that any progressive planter would be simply content to run cattle without making an effort to keep the noxious weeds, such as "Koster's Curse," Lantana and other pests down.

Mr. Barnes.—An important point in regard to use of leguminous plants in crop rotations, whereby the pernicious system of shifting cultivation,

so largely practised by natives in many parts of the world could be obviated, was not mentioned by Mr. Surridge. In Nigeria, East Africa and in parts of Fiji the native cultivator grows crops on a patch of land until yields fall off owing to the exhaustion of the soil. He then moves to another patch which he clears, plants and deserts in the same manner. These patches of deserted cultivation become rapidly covered with secondary bush and provide a splendid home for noxious weeds, thus becoming a source of infection for the areas around them. In Nigeria the Department of Agriculture has for some years experimented with systems of crop rotations, including the use of leguminous crops, to enable the natives to keep the same area of land in cultivation year after year. Such work is necessary here in Fiji, and Mr. Surridge's observations on the conditions of green manuring apply perfectly to the improvement of native systems of agriculture. In the issue of the *Agricultural Journal* for the last quarter of 1929 reference was made to an address of Mr. Stockdale, Agricultural Adviser at the Colonial Office, on the subject of soil erosion. This is a matter of vital importance to Fiji. We have excellent examples of the results of soil erosion in our river flats which consist entirely of soil eroded from the higher lands and brought down and deposited in the flats by the streams. Valuable as these river flats are, it must be borne in mind that the hillsides from which they have been derived have been denuded of soil and their capability of supporting vegetation thereby reduced. Examples of the wrong system of cultivating slopes are with us in Fiji. It is quite improper to plant on such land in the direction of the slope as soil erosion is thereby encouraged. Sloping land should be cultivated and planted parallel to the contour lines, that is at right angles to the line of the slope at any point, in order ultimately to secure a terraced effect, thus checking the washing away of the valuable surface soil. Here again the practice of green manuring is a valuable asset as surface washing can be largely checked if the ground is kept covered.

His Excellency the Governor.—I now ask Mr. Tarby to read a paper on Indian Agriculture in Fiji.

INDIAN AGRICULTURISTS' CONTRIBUTION TO THE AGRICULTURAL PRODUCTION OF THE COLONY.

By J. P. TARBY, Manager, Government Rice Mill.

IN respect to agriculture, Fiji may well boast of many assets and natural resources such as mild climate, dry and wet zones, fertile soils and abundant water-ways, &c. Perhaps, however, the foremost asset is the Indian agriculturists and their co-producers, the Indian labourers. Indeed, since it may now be assumed without fear of contradiction that the great majority of the present Indian population has made Fiji their permanent home and that their progeny can be counted upon also to remain here, the Indians may be likened to one of Fiji's natural resources. But, like all natural resources, unless utilised, they are, in respect to agriculture, of little economic importance, and unless properly and discreetly utilised, they cannot yield of their best. This is a maxim that should be applied to the Indian agriculturists and their co-workers, the Indian labourers. Conversely, as no natural resource can yield its worth or wealth of its own accord, that is, without organisation, direction and the outlay of some capital to exploit it, the Indian agriculturists cannot, more especially if expected to produce

in various directions, produce of their own initiative, that is, without tuition, direction and assistance (not necessarily in money) for their utilisation. This is another maxim that should be applied to the Indian agriculturists and their co-producers in Fiji. Strange to say the comparison of the Indian agricultural community to a natural resource has greater truth in it than at first meets the eye. Compare them for example, to the newly formed auriferous sandy deposits to be found in various parts of the world. Valuable, but hopelessly disunited, except by a common temporarily binding, but weak agency—water in the case of the sandy deposits and nationality in that of the Indian agricultural community. The time will come when the Indian agricultural community will be bound into a whole by firm and lasting agencies, but pending that time, which can only be reached by the slow process of tuition, co-operation and organisation, artificial means (European leadership and control) must be applied if greater production in agriculture is to be sought among them, more particularly among the agriculturists outside the sugar industry.

These three main points should be borne well in mind, and acted on, if the Indian agricultural community is expected to contribute in a fair measure to the agricultural production of the Colony. As colonists, and in fairness to themselves and to their adopted country, they should, and would, if the above maxims were more generally applied. When expounding these views to a European elected member lately he opposed them on the ground that it would be pampering the Indians. What fallacy! More especially when it is considered that the Indian is here for the advancement of production rather than for social reasons. Moreover, can any means wisely applied in the direction of production or greater production, be it to a human being, a horse, or a piece of machinery, be misconstrued into pamperism? For answer I direct any doubting person to the Colonial Sugar Refining Company, their treatment (pamperism?) of the Indians, and their success and profits. The necessity for the application of these main points becomes all the more evident when it is considered that due to lack of organisation and co-operation among themselves, their inborn propensity for false economy and their lack of business knowledge from a broad point of view, the Indian agriculturists and their helpers, when and wherever acting on their own initiative, that is, away from European leadership and control, find themselves at a great disadvantage in that there is no co-operative ownership of implements, live and transport stocks, nor can they perform certain essential works on co-operative lines, nor do they know what to grow, how best to grow it and how and where to dispose of it to the best advantage. This estrangement from European leadership and control leads also to a desire to live a purely village life, that is, to produce very little more of their own staple food than is needed to exist on, and, practically nothing else.

The ascertainment of the exact production by the Indian agriculturists, which includes a few indispensable Indian wage-earners, is not easily arrived at for the reason that the agricultural statistics of the Colony are unreliable, if not misleading, but a fair estimate of their production can be formed by round about means. For this purpose, I have prepared certain tables based on imports, exports and estimates which, I think, go a long way towards exhibiting the relation of the Indian agricultural community to the agricultural production of the Colony. Due allowance will have to be made for the figures based on estimates, but I venture the opinion that while the itemised figures may differ, the aggregate of the estimated production is not far out one way or the other. At any rate, it is only by large

omissions and commissions in those estimates that the *per capita* production can be materially affected. I do not, however, see where they can arise. The net result of these tables point to four important facts, viz.—

- (1) that the average *per capita* production by the Indian agricultural community is not nearly as high as it should be;
- (2) that the *per capita* production by the cane-growing Indian community is 157 per cent. more than the *per capita* production by the Indian agricultural community outside the cane-growing-areas;
- (3) that the production by the Indian agricultural community outside the cane industry, is not only very low but that it is on the decline;
- (4) that the Indian agricultural community when not under the leadership and control of Europeans, ceases, practically, to be of economic importance in respect to agriculture.

Dealing with the main points of the tables, (see appendix), the following is to be gleaned:—

Imports, 1923–28.—(a) The average (£1,455,090) of total imports into the Colony has increased in value by 25 per cent. since 1923.

(b) The importation of Indian foodstuffs (rice, sharps, dhal, mustard oil, ghee, spices, potatoes and onions) has increased (in aggregate value) by about 33 per cent. since 1923.

Exports, 1923–28.—(c) The average value (£1,870,259) of total exports of the Colony has increased by 28 per cent. since 1923.

(d) The average value (£60,299) of exports of products with which Indians, as labourers only, are hardly connected, shows decrease in some products and increase in others.

(e) The average value (£1,148,339) of export of products (sugar, molasses and rubber) with which Indians, (as labourers and mostly as growers) are largely connected, but under leadership, control and organisation of Europeans, has increased 63 per cent and 69 $\frac{3}{4}$ per cent. for sugar and molasses respectively, and decreased 45·83 per cent. (£3,900) for rubber.

(f) The average values (£14,067) of export of products produced and controlled entirely by Indians, with slight assistance (manufacturing, shipping and sales) from Europeans, have decreased as follows:—Cotton, 50 per cent.; cotton seed, 59·44 per cent.; pineapples (fresh), 21·94 per cent.; and maize, 100 per cent.

(g) The average ratio (in group values) of average values of imports and exports as in (a), (c), (d), (e), and (f) enumerated above to the total average values of imports and exports works out as follows:—

		Per cent.	£
Imports—(a)	.. ..	7·24	89,896
Exports—(c)	.. ..	3·22	60,299
„ (d)	.. ..	34·81	651,090
„ (e)	.. ..	61·40	1,148,339
„ (f)	.. ..	0·75	14,067

(h) The total estimated average value of the locally grown and consumed products (rice, dhal, maize, pineapples, spices, tobacco, mauritius beans, milk, ghee and vegetables) over and above the values (£14,067) of such products exported, produced by Indians outside the cane-growing areas, amounts to £129,104.

(i) The estimated average value (£129,104) of products grown and consumed locally, treated as exports and added to the average value of total average exports (£1,870,259) increases the average value of total average

exports to £1,999,363. On this basis the percentages and values given in (g) now are:—

Imports—(a)	.. .. .	Not affected.
Exports—(c)	 3.02%	60,299
„ (d)	 32.56%	651,090
„ (e)	 57.45%	1,148,339
„ (f)	 7.15%	143,171

(j) The total number of Indians estimated to be engaged in agriculture including 2,500 co-workers, is 20,750 (adult males) and their yearly *per capita* average production is £39 18s. 2d. While their distribution is:—Sugar industry, 13,750; Other industries (outside cane industry), 7,000; total, 20,750.

(k) The estimated *per capita* yearly production of the 13,750 Indians directly and indirectly engaged in the sugar industry is £52 11s. 0d., and that of the 7,000 Indians engaged in industries other than the sugar industry is £20 9s. 0d., leaving an increased *per capita* balance in favour of Indians under European control of 157 per cent. or £32 2s. 0d. per annum.

(l) The estimated Indian population at 31/12/29 is 71,000 and the occupational distribution of the population is estimated to be:—

directly and indirectly engaged in and dependent on the sugar industry, 15,000 adult males, or with women and children, 51.38 per cent. of the population;

engaged in agricultural industries, other than those of sugar, rubber, coconuts, bananas and vegetables, 7,000 adult males, or with women and children, 24.0 per cent. of the population; and

engaged in commercial, domestic, &c., enterprises and as labourers in rubber, coconut and banana industries, 7,212 adult males, or with women and children, 24.68 per cent. of the population.

Much more information could be given but I think sufficient evidence has been produced to warrant the verdict that greater production could be attained by the Indian agricultural community than has been shown, more particularly by the members of the community engaged in industries other than that of sugar. Based on the *per capita* production of those engaged in the sugar industry, the Indians outside this industry could increase their present *per capita* production by 157 per cent. that is, they could produce most of if not all the Indian foodstuff now imported (about £90,000 worth) besides providing all the rice needed for local consumption (10,000 tons) and some 500 tons more for export. Further they could produce 2,000 bales of cotton, 300 or more tons of maize, 100 tons of mauritius beans and 300 or more tons of pineapples (fresh) for export, as well as quantities of sesame, cotton seed and groundnut for the manufacture of margarine, locally, to take the place of ghee and for export, also coriander seed and linseed for export, besides many thousands of tons of pineapples for canning purposes. Regarding the Indians engaged in the sugar industry, their *per capita* production, though very fair, should be increased by the growing of rice for home consumption. For reasons to be adduced later, every man on the land, regardless of the industry he is engaged in, should be made to grow sufficient rice to provide for himself and his family.

While it is possible to increase the agricultural production of the Indian community outside the sugar industry from the present average production of £129,104 to from £300,000 to £350,000, very little improvement on the present production can be looked for unless two or more European Inspectors with an Indian staff are appointed to do all things possible to further production. The material is at hand, but needs to be moulded into shape. This

may mean much endurance and take time, but the goal is well worthy of an attempt. Chair-legislation in regard to agriculture among the Indians has ruled for many years with the poor result evidenced; let us now, I say, be up and doing for the betterment of the Indian agricultural community and for that of the Colony in the way of greater production. In the event of a desire to improve the present agricultural conditions among a certain class of the Indian agricultural community, and with the view of facilitating and expediting the carrying out of this desire, I have prepared, for Departmental use only, a set of papers giving a short local history of each product now grown by Indians, with suggestions for the growing of new ones, and making tentative recommendations for the improved and greater production of each. To assist further I would venture a general recommendation to concentrate without delay on greater production of Indian foodstuffs and on the extension of the cotton industry and the possibilities of the greater expansion of the pineapple industry to meet contingencies in the event of a set-back to the sugar industry arising from the combined effect of the total or partial removal of the preferential tariff and the low price of sugar throughout the world. Other sugar-producing countries are being sorely tried by the depressed state of the sugar market due to overproduction. Should it be found necessary to reduce the price of cane here by the removal of the bonus of three shillings per ton of cane (equal to 24 per cent or £12 on the present *per capita* production) the Indian cane-growing community would be appreciably impoverished, but should greater curtailment in the price and a reduction in the production of cane have to be made, then the large proportion of the Indian population dependent on the sugar industry would be in a very sad plight indeed unless there was sufficiency of cheap food and certain other commercial agricultural industries they could take up, to relieve the depression.

See inserted Tables.

His Excellency the Governor.—I thank Mr. Tarby for his interesting paper which indicates very careful research. The enterprise of our Indian population compares favourably with that shown in other parts of the world, but, of course, it is obvious that there is much more scope for the Indians in agriculture, and it is our object as far as we possibly can through the Agricultural Department to assist them to grow proper crops and to grow more crops. I hope the Indians present to-day will join us in the discussion and give us any information which may be of use regarding their needs.

Mr. Grant.—The trouble amongst the Indian agriculturists is finance. The Colonial Sugar Refining Company have a good system. A man might have five acres of land which he wants to plant. He works very hard and two or three acres are planted and he then finds that he cannot plant any more. I think the Government should consider the establishment of an Agricultural Bank in the same way as is done in India and if this was done it would help things along very nicely. Of course, there are money-lenders, but they want such a high rate of interest.

Mr. Turbet.—I agree with the remarks made by Mr. Grant. The Colonial Sugar Refining Company advance money to their tenants and when the crop is crushed the advances are repaid and the Indian cultivator is still left with a surplus. I think Mr. Tarby said that Indians working under that Company received £51 per annum while those working on their own only received about £20. If some means could be devised whereby

the Indians were assisted financially I think they would make a bigger return.

Mr. Grant.—With reference to the Indians working for the Colonial Sugar Refining Company they have no trouble about the cutting of their crops. They supply the labour and also pay wages. In districts like Navua for instance, all the crops are ready together and an Indian finds it difficult to get labour to help him harvest his crop.

His Excellency the Governor.—I thank you for your valuable contribution to this discussion. I am quite in agreement with your ideas. The matter is one of some difficulty and I would welcome any considered suggestions from the Indian community as to how we should go about it. I will ask Mr. Barnes whether he can devise some means which will enable the Indians to work in co-operation with the Agricultural Department.

Mr. Grant.—Some time ago six Indian lads went to India to study agriculture. They have now returned to Suva and I think it would be a good thing for Mr. Barnes to see them. I would like to see it made possible for some more Indians lads to be trained in agriculture.

Mr. Barnes.—I am very much obliged for the valuable suggestion. I shall be glad to meet those interested in agriculture. Several of your community have already visited me. I can assure you that I shall be most happy to interview any of your people at any time provided they make arrangements to see me.

Mr. Vishnu Deo.—I do not agree with Mr. Tarby's statement about Indians requiring European leadership. I think it is always better for Indian farmers to be settled on the land under nobody's control. I consider that they should be given financial assistance to enable them to get on the land. It would be better if an Agricultural Bank was established. But money is not the only trouble that Indians have to face. Sometimes they cannot get the land. They make an application and this is submitted through the usual channels and then it is turned down because the natives will not surrender the lease. Then there is the question of transport facilities which in most country districts are very poor because of the lack of roads. Produce has to be carted by bullock wagons and across rivers, and this is very expensive.

His Excellency the Governor.—This discussion is of the greatest interest to me. With regard to the leasing of land I can assure you that the question of a better system of land tenure is receiving attention and I am forwarding proposals to the Secretary of State. With regard to transport I consider that this question is entirely wrapped up in the question of the prosperity of this Colony. I hope that before long we shall have a road running direct to Sigatoka. There is also the question of subsidising small vessels to run regular trips between the various islands. I am pleased to inform you that the Secretary of State is enquiring as to the possibility of transport by seaplane between the various islands. I think this is a vital matter and I consider that an improvement in transport facilities will be of the greatest assistance to the Indian community, and indeed to the whole Colony.

Mr. Grant.—Thank you very much, Sir, for your remarks. I can assure you that we all want to co-operate with you in advancing the prosperity of the Colony.

Mr. Barnes.—I think the discussion might conveniently be closed by my summarising the important points which have been raised. The whole theme is one of organisation of Indian agriculturists. The Colonial Sugar Refining Company is, in fact, an agricultural organisation which includes provision for the points raised by Mr. Grant. Financial assistance is an

important matter in connection with their organisation. The discussion has brought out the fact that some scheme for financial and instructional assistance to Indian agriculturists is necessary and His Excellency has instructed me to prepare such a scheme for his consideration. Mr. Tarby in expressing his views has called attention to the comparatively poor returns made by Indians outside European agricultural organisations. Mr. Grant and Mr. Vishnu Deo have pointed out that the whole trouble is lack of finance—lack of capital. These difficulties have been overcome in other countries and there is no reason why they should not be overcome here. Co-operation is essential. The important points brought out in the discussion will stimulate the Agricultural Department to inquire into these vital matters.

His Excellency the Governor.—I now declare this Conference closed. I wish in the first place to congratulate Mr. Barnes on the success of this first meeting and I wish also to express my appreciation of the part taken by all members of the Department. I am always talking about education. I think education is of vital importance, but it does not merely mean the teaching of the "three R's." The first thing is to find efficient teachers, and in the staff of the Department of Agriculture I am satisfied that we have excellent men to teach the community. I might state that Mr. Barnes has suggested that future Conferences could be arranged at the time the Agricultural Show is being held, which is usually in October. I think this is an excellent idea. I hope that members of the public will contribute Papers on their own account. It would be most interesting for us to have the experience of practical men on agricultural questions.

FIJI LIVESTOCK RECORD ASSOCIATION.

MINUTES OF MEETING OF BOARD OF DIRECTORS HELD ON JANUARY 16, 1930.

THE following were present:—Superintendent of Agriculture, (Chairman), Senior Veterinary Officer, G. Kiss, Esquire, and J. Barber, Esquire.

The minutes of the last meeting of the Board were read and confirmed.

Position on Animal of Association Brand.—At a meeting of the Board held on the 24th October, 1929, the Board directed:—

"That owners of stock should be permitted to brand registered animals on such conspicuous parts of the body as they should desire."

After discussion the Board decided that, in conformity with the provisions of the Brands Ordinance, the Association's brand should be placed on the near neck or on either cheek, the earlier direction being repealed.

Annual Report.—The Board approved of the Report which has been prepared for submission to the Annual General Meeting of the Association.

Date of next Meeting.—The Board directed that the next meeting should be held on the 10th April, 1930.

MINUTES OF ANNUAL GENERAL MEETING HELD ON THE 16TH JANUARY, 1930.

The following were present:—Superintendent of Agriculture, (Chairman). Messrs C. R. Turbet, H.M. Stuchbery, J. Barber, G. Kiss, L. N. Bean, A. Barker and G. D. Hill.

The minutes of a special general meeting held on the 15th October, 1929, were read and confirmed.

Annual Report and Financial Statement.—The Honorary Secretary read the Annual Report and financial statement which were adopted on the motion of Mr. Barker, seconded by Mr. H. M. Stuchbery.

Appointment of Honorary Auditor.—On the motion of Mr. Barker, seconded by Mr. Hill, the meeting directed that Mr. P. J. A. Hamilton be requested to act as Honorary Auditor to the Association.

ANNUAL REPORT FOR THE YEAR 1929.

The Board of Directors of the Association submits the following report in respect of the year 1929.

Members will remember that the inaugural meeting of the Association was held on the 1st September, 1927, that little progress was made and that until October last the Association was, to all intents and purposes, defunct. With a view to reforming the Association the Superintendent of Agriculture, Chairman of the Board, called a meeting on the 15th October last. At that meeting, at which 12 gentlemen were present, it was decided to reform the Association.

Election of Board of Directors.—Under the rules of the Association the Board consists of the Superintendent of Agriculture (Chairman), a Government Veterinary Officer and three elected Directors. The Directors elected at the meeting on the 15th October last were:—Mr. J. Barber, Mr. R. Craig, and Mr. G. Kiss.

The Superintendent of Agriculture appointed Mr. A. B. Ackland to be Honorary Secretary of the Association.

At the Special General Meeting members recommended to the Board of Directors that action be taken to:—

- (a) seek approval for the use of the *Agricultural Journal* as the official organ of the Association;
- (b) amend the Rules of the Association to provide, amongst other things, for reduced membership and registration fees.

As the Association was not re-formed until the middle of October the Board held only one meeting during the year.

The Rules of the Association have been amended on the lines proposed by members and approved by the Board and duly published in the *Royal Gazette*. They are published in the last issue of the *Agricultural Journal* and your Board now await separates for distribution to members.

His Excellency the Governor has been good enough to approve of the use of the *Agricultural Journal* as the official organ of the Association.

The Association's brand has been decided upon and application has been made for the registration thereof.

Your Secretary has addressed some 35 gentlemen in regard to becoming members of the Association. As the amendments to the Rules were not published until the 13th December it was not possible to do much towards the enrolment of members before the end of the year.

Together with the amount carried forward from 1928 the balance at the credit of the Association's Account at the 31st December, 1929 was £7. There were no items of expenditure during the year.

The financial statement placed before you at this meeting has not been audited as the appointment of an Auditor, as provided by the Rules, has not been made. Your Board of Directors recommend that the Auditor, when appointed, should examine the accounts for the year under review.

FIJI LIVESTOCK RECORD ASSOCIATION.

STATEMENT OF ACCOUNT.

<i>Expenditure.</i>				<i>Revenue.</i>			
To Balance carried forward				By Balance brought forward	£4	0	0
to 1930	£7	0	0	By Subscription paid 1929 .	3	0	0
	<u>£7 0 0</u>				<u>£7 0 0</u>		

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